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THE FAMILY HARPIDAE OF THE WORLD

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Introduction

The family Harpidae includes as their most dominant element the harp shells of the tropical seas. These striking and colorful shells have long been favorites with collectors, although because

of the paucity of species in the genus and the relative rarity of most of the species, they have not been as popular a group as the cowries, the cone shells, and the volutes.

They have, however, been the subject of iconographic treatment by numerous authors: Kiener (1835), Reeve (1843), Chenu (1853), Küster (1857), Sowerby (1860), Tryon (1883), and Maxwell Smith (1948). The only really critical study to date of the genus is that of Sutor (1877). Hedley (1911) published a short note updating the nomenclature of the species.



Plate 183. Above: *Harpa amouretta* Röding, showing head region with the inhalent siphon and the left tentacle with the eye at the base. Oahu, Hawaii. X 2. Photo by Olive Schoen-

berg. Below: *Harpa major* Röding, showing autotomized posterior portion of the foot. Nuku Hiva, Marquesas. X 1. Photo by Otis Imboden, National Geographic Society.

Family characters

The Harpidae is one of the seven families comprising the superfamily Volutacea (considering the Vasidae and Turbinellidae as distinct families) of the order Neogastropoda, and is usually placed near the Olividae and Turbinellidae. As a matter of fact, the subfamily Harpidae was once placed in the family Olividae, undoubtedly because of the similarities in the characters of the foot and propodium and the extent of the parietal callus.

The shell is characterized by possessing a large body whorl marked by more or less strong ribs, with the spiral sculpture, if present, of secondary importance. The protoconch in this small family is notable for the variety shown in its form and in the number of its whorls. These nuclear differences are used to separate the genera and subgenera, and are mentioned in the key (p. 000) and in the diagnoses of the supraspecific groups. For representations of the various types of protoconchs see our illustrations. The aperture varies from broadly to narrowly ovate; the parietal and columellar areas of the ventral side are covered by a callus of varying extent. The anterior siphonal sinus is well-marked, a siphonal canal is very short or absent, and there is generally a shallow posterior sinus at the junction of the outer lip and the parietal wall. An operculum is absent.

The living species of *Harpa* have a shell vividly ornamented with reddish brown and various shades of pink in more or less intricate patterns. The shells of *Austroharpa* are brightly colored, with or without spots, or their color pattern may be restricted to scattered spots.

According to Quoy and Gaimard (1832-35, vol. 2, p. 617), shells of the males are always narrower than those of females.

The foot of the animal is very large and fleshy, often with a rough, rugose surface, and is con-

spicuously divided into two parts. The propodium is broadly arcuate in front, terminating laterally in points that extend well beyond the width of the hind portion of the foot, or metapodium; the anterior margin may be shallowly scalloped and is sometimes more or less furrowed or grooved vertically. The propodium is joined by a broad neck to the metapodium which is elongately lanceolate, tapering posteriorward to a point, with its margins also gently and undulatingly scalloped.

The head, when the animal is active, is usually hidden beneath the anterior edge of the shell with only the tentacles and long inhalent siphon visible. The siphon protrudes through the siphonal notch, and the tentacles, when the animal is viewed from above, emerge from each side of the siphon. The tentacles are slender, pointed, and bear the eyes at the anterior end of a lateral enlargement above the base of the tentacles. From near the base of the head on the right side arises in males the elongate, tapering penis. In a specimen of *Harpa amouretta* from Nuku Hiva, Marquesas, I was able to see the rather long extruded part of the proboscis. In the Harpidae this organ is of the pleurembolic type, in which only the basal part is invaginable, withdrawing the distal portion into a sheath in the body cavity; this sheath is depicted by Quoy and Gaimard in one of their drawings.

All exposed parts of the animal are usually vividly mottled and flecked with various shades of brown or red, from deep chestnut brown to pale brown or reddish brown, and sprinkled with spots of bright yellow. The tentacles and inhalent siphon are irregularly ringed with chestnut brown and also spotted with yellow. The penis either is sprinkled with very fine spots of reddish brown or is without spots. According to Quoy and Gaimard the base of the foot is lightly spotted or

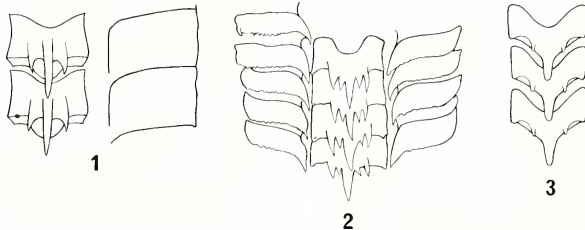


Plate 184. Radular teeth of: 1, *Harpa amouretta* Röding, X 600 (after Peile, 1939); 2, *Harpa amouretta* Röding, (after

Bergb, 1901); 3, *Harpa major* Röding, (after Troschel, 1866).

flecked with pale reddish brown. In preserved animals these colors first turn a more or less scarlet red and then usually fade.

The living animals and the anatomy of *Harpa major* and *H. amouretta* have been described and figured by Quoy and Gaimard (1832-35, vol. 2, pp. 611-620, pl. 42), and Bergh (1901) has published anatomical notes on *H. ventricosa*, *H. major*, *H. doris*, and *H. amouretta*. Earlier Reynaud had described the anatomy of either *major* or *dauidis*, based on specimens from Ceylon (of which the shells are not described). His paper was read in 1829 but was published later (Reynaud, 1834); the figures in his paper are rather crude.

The radula of *Harpa* is very small, and Quoy and Gaimard were unable to find it in their examination of over twenty animals. Macdonald was apparently the first to discover the radula, which he said was "very minute compared with the whole bulk of the animal, as to appear quite rudimentary" (Macdonald, 1957, pp. 359-390). The radula was described and figured by Macdonald (1869, p. 116, pl. 13, fig. 14), and in the same year Troschel described that of *H. major* (Troschel and Thiele, 1866-93, p. 105, pl. 10, fig. 1). Troschel suggested the possibility that the radula teeth disappear in the adult stage, since the specimen of which he examined the radula was a juvenile. This probably accounts for Cooke's categorical statement that there is no radula in the adults of *Harpa* (Cooke, 1895, pp. 216, 221). Peile has figured and discussed the radula of *H. amouretta* (Peile, 1939, pp. 271-272) as has Bergh (1901, p. 625, pl. 47, fig. 21). For copies of some of these radula drawings, see plate 184. Attempts to extract the radula from a specimen of *Harpa costata* were finally successful, but in the process of staining and fixing, the radula became twisted on itself, and it was not possible to get a flattened

section of the radula. I was able, however, to confirm Peile's statement that the mesocone of the rachidian projects forward as a fang-like tooth. It appears that on each side of the mesocone is a single small cusp. On either side of the rachidian is a broad, segmented membrane that may, as Peile suggests, be the remains of the bases of lateral teeth.

Biology

Most of the living species of the genus *Harpa* live in moderately shallow to rather deep water where they progress over the sand or hard bottom and burrow in the sand by means of their large and strong foot. Reynaud (1834, p. 35) says that they move by using their propodium as a point of attachment and pull the rest of their body forward. I have not observed this in the living specimens I have seen, and other writers have not mentioned this means of progression.

Their mode of burrowing in the sand is described in a letter from Mrs. E. Coucaud of Port Louis, Mauritius. She observed *Harpa major* entering the sand with the shell perpendicular "until it was completely covered with sand. Then immediately by two or three successive movements I understood it had taken the horizontal position again, and then the tip of the siphon appeared from beneath the sand." Chabouis and Chabouis, in a natural history textbook for French Polynesia (Chabouis and Chabouis, 1954), say that after *H. major* has buried itself in the sand the only trace is a small hole in the center of a low mound which reveals the location of the siphon.

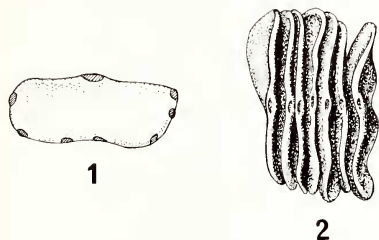


Plate 185. Egg capsules of *Harpa major* Röding from Hot Tibarama, east coast of New Caledonia. 1, single egg capsule showing the "pore" at the top and 7 attachment scars. 2, view from top of cluster of egg capsules (after Risbec, 1932).

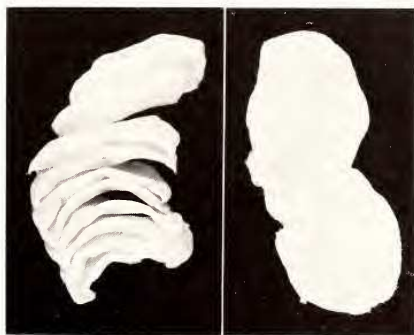


Plate 186. Egg mass of *Harpa amouretta* Röding from Batangas Province, Luzon Island, Philippines. Left fig. 11 capsules, about 40 mm. in width. Right fig., single capsule, showing pore at right, and broken attachment points at the left. Photo courtesy of R. Tucker Abbott.

An aspect of the behavior of species of the genus *Harpa* that has attracted the attention of even the older naturalists is that of autotomizing (self-amputation) the posterior portion of the foot when disturbed. Rumphius as early as 1705 mentions this habit. This trait, found also in some other genera of marine and land snails that possess a large foot, has been discussed at length by Quoy and Gaimard (op. cit.), Reynaud (op. cit.), and Jousseau (1853). Crichton (1941, p. 330) describes the autotomy of the hind portion of the foot of *H. davidis*, emphasizing the readiness with which this occurs. Several specimens of *H. major* dredged in the Marquesas severed the posterior portion of the foot (pl. 183), the severed ends of each part showing a clean edge (pers. obs. 1967). We did not notice any line of demarcation where the break occurred; Reynaud (op. cit.) states that there is such a line, but Quoy and Gaimard deny this.

Stasek (1967) has published a paper on autotomy in general, in which he cites the observations on *Harpa* by Quoy and Gaimard and Reynaud. In a recent article by Hardy (1972), autotomy in *H. ventricosa* and *amouretta* is described and figured.

None of the previous writers have published anything on the food of *Harpa*. Quoy and Gaimard state that they found nothing in the more than twenty stomachs of *Harpa* they examined, and believed that their food must be tenuous and readily assimilable. The first information on the feeding habits seems to be that of Chabouis and Chabouis (op. cit.). As this book, published in 1954, is not readily available, I give here a free translation of the pertinent paragraph:

"We have ascertained that the harp shell feeds on small crabs living in the sand, principally the box crab, *Calappa hepatica*, and the swimming crab, *Neptunus* [= *Portunus*] *sanguinolentus*. The anterior portion of the foot [propodium] holds the crab immobile on the substrate and the posterior portion [metapodium] glides underneath the crab, rolling itself around the imprisoned crab. At the same time the *Harpa* secretes a sticky fluid which combines with the sand to form a sort of a coating over the crab, asphyxiating it. We have seen a *Harpa* leave the sand while discarding the empty carapaces, probably after a meal."

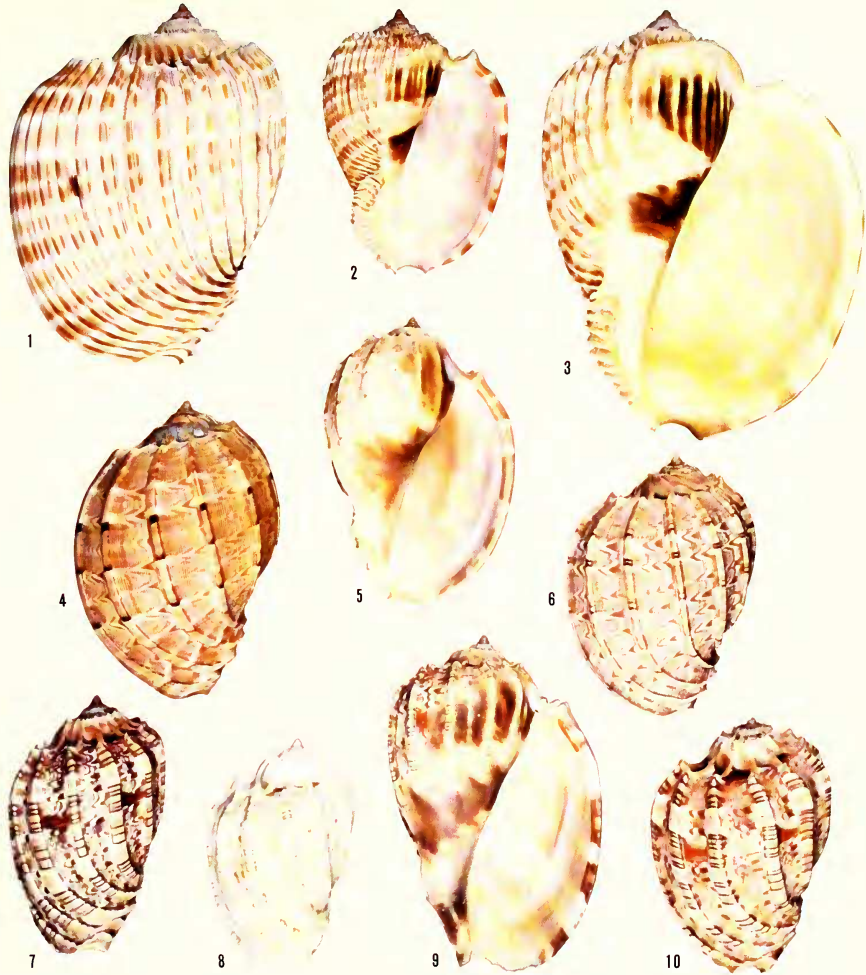
This observation is confirmed by Mrs. Coucaud in a letter from Mauritius in which she wrote that she has seen *Harpa major* "lying on one side with the animal rolled like a ball around a small crab or shrimp which it was surely eating. I do not remember having noticed this with *Harpa minor*, however."

It is possible that the mucus or some other secreted fluid contains a toxin that immobilizes or kills the crab on which the *Harpa* feeds. How the carapace and other hard parts of the crab are attacked by the snail in order to get at the soft parts is not known. The long proboscis is well suited to suck up the juices of the victim, the tiny radula possibly acting to reduce the larger pieces of flesh.

Harpa has several rather conspicuous mucus glands in the body cavity which can secrete large quantities of mucus when the animal is disturbed, as we discovered when picking out living specimens in the dredge hauls we made in the Marquesas. Quoy and Gaimard comment on the difficulties that the coagulated mucus caused during their dissection and examination of *Harpa major*.

The only literature reference to the eggs of *Harpa* that I have found is the note by Risbec on a female of *Harpa major* (he used the name *Harpa nablium* Mart.) that he found in New Caledonia depositing eggs (Risbec, 1932, p. 368). The snail when discovered had not yet completed the task, and with her foot covered the whole egg mass which was attached to a rock. The ootheca are lamellar, rather tough, roughly rectangular in shape, about 30 mm. long and 15 mm. high, and irregularly attached to each other. The opening is in the center of the upper edge, and each capsule contained about three to four thousand yellowish white eggs. In shape the individual egg capsules are rather like those of certain species of *Busycon*, and when viewed from above the serially arranged capsules remind one of a portion of a *Turbinella* or a *Busycon* egg mass (Plate 185).

Dr. R. Tucker Abbott kindly examined and photographed for me the egg masses of *Harpa amouretta* Röding. The first egg mass (Plate 186) was laid by a female (typical shell form, Pl. 189, figs. 6-8) from Batangas Province, Luzon, Philippines, on March 25, 1965, and consisted of eleven lamellar, rather pliable, tough, rectangular ootheca, about 40 mm. in width and 20 mm. high. At the top of each capsule is a lanceolate pore with a thin membrane covering it. The pore and the continuing slit on each side offers a potential opening of 20 mm. in length. The capsules have 5 to 7 points of attachment to each other. The shell length of the female is 46.8 mm.; its width is 28.0 mm. The second egg mass also consisted of eleven capsules, but they were more arching in shape and only 25 to 30 mm. in width. They were laid on June 12, 1966, on Panay Island, Philippines, by a female whose shell size is 44.5 x 26.5 mm. Approximately 3,000 to 4,000 eggs were in each capsule. The egg capsules were collected

Plate 157. *Harpa* from the Indo-Pacific.

Figs. 1, 2, 3 *Harpa costata* (Linné, 1758). 1, Fouquet Id., Mauritius (ANSP 265220); 2, immature from Mahébourg reefs, Mauritius (Del Mus. Nat. Hist. 12246); 3, La Morne, Mauritius (USNM 666304).

Figs. 4, 5, 6 *Harpa davidis* Röding, 1798. 4, Rameshwaram, southern India (USNM 290884); 5, Indian Ocean (USNM

700307); 6, Indian Ocean (Del Mus. Nat. Hist. 12248).

Figs. 7-10 *Harpa harpa* (Linné, 1758). 7 and 8, Losap Id., Mortlocks, Caroline Ids. (Del Mus. Nat. Hist. 37567); 9, Siasi, Sulu Archipelago, Philippines (USNM 612453); 10, Ryukyu Island (USNM 343465).

and preserved by the well-known collector, James E. Norton, now of Arizona.

Reynault has recently published on the characters and origins of the apyrene spermatozoa found in *Harpa amouretta* (Reynault, 1965).

Classification

Linné placed the two species of harp shells that he described in his genus *Buccinum*. The first to give these shells a distinct generic appellation was Röding, who in 1798 used the name *Harpa*, including in this genus six validly named species. Lamarck a year later independently created the genus *Harpa* for the same group.

The harp shells were first placed in a distinct family by Bronn, who in 1849 proposed the family Harpina (Bronn, 1849, p. 469), including in this family also the genus *Dolium*. Early classification systems generally assigned the genus *Harpa* to the family Buccinidae (Gray, 1847, p. 138; Woodward, 1851, p. 116). H. and A. Adams (1853-54, p. 116) put *Harpa* in the subfamily Harpinae of the family Dactylidae (= Olividae), probably on the basis of the similarity in the nature of the large foot, parietal callus, and the absence or small size of the operculum. In this arrangement they were followed by Gray (1857, p. 26). Chenu was the first to use the family name Harpidae in the modern sense (Chenu, 1859, p. 204), and was followed in this usage by all later workers.

The first person who appears to have published on the differences between the then known living and fossil species was Jousseauine, who in a short paper (Jousseauine, 1881) pointed out these differences and suggested using the name *Cithara* Klein for the recent species, and restricting the name *Harpa* Lamarck to the fossil species. As the type species of *Harpa* is the recent species *H. harpa* Linné, *Cithara* 'Klein' Jousseauine, 1881, falls into the synonymy of *Harpa* Röding.

In 1883 Fischer (1880-87, p. 601) proposed *Eocithara* as a section of *Harpa* for the fossil species. He also included *Silia* Mayer, 1877, as a subgenus of *Harpa*; this group, however, should probably be placed in the Volutidae, as it was put with a query by Cossmann as a subgenus in *Cryptochorda*, which he assigned to the family Harpidae (Cossmann, 1899, p. 78); the latter genus is now generally placed in the Volutidae.

For many years *Eocithara* was used as a subgenus of *Harpa*; Wenz (1943, pp. 1309-1311) has four subgenera under *Harpa*—*Harpa* s.s., *Eocithara*, *Marwickara* Laws, 1935, and *Austroharpa* Finlay, 1931. Most recent workers in New Zealand and Australia, however, consider *Austro-*

harpa and *Eocithara* as distinct genera, an arrangement I am following in this paper.

Distribution

The living species of Harpidae are found in the tropical and subtropical waters of the world, absent only from the western Atlantic.

Of the two groups found living today, the genus *Austroharpa*, subgenus *Palamharpa* is restricted to the warm-temperate waters of southern Australia, from the southernmost part of Queensland, around the southern coast, to the vicinity of Perth, Western Australia. All these species live in moderately deep water, in 20 to 100 fathoms, and are rather rare.

The genus *Harpa* includes the brightly colored, strongly ribbed harp shells well-known in collections. Of the ten recognized species eight are found in the Indo-Pacific region. Only two of these are widely distributed over much the entire region; these are *amouretta* and *major*. *Harpa harpa* is almost as widely spread, but is rare in the Indian Ocean, and is not found in Polynesia, its range reaching only to the Gilbert Islands in Micronesia and Tonga in eastern Melanesia.

Two species, *ventricosa* and *costata*, have a restricted distribution in the western Indian Ocean. *H. davidis* is found only in the eastern Indian Ocean, and *H. articularis* is restricted to the southwestern Pacific Ocean. *Harpa gracilis* is a rare species found only in the coral atolls of the central Pacific, from the Ellice Islands to the Tuamotus and Clipperton Island.

The remaining two species of *Harpa* are found outside of the Indo-Pacific: *H. doris* along the West African coast and on Ascension Island, and *H. crenata* in the Panamic province.

Most of the species of *Harpa* are found in moderately deep water, and have been collected alive only by dredging, diving, or being found in fish traps. Only of *amouretta* have we definite knowledge of being found in shallow water and on reef flats; *gracilis* may also have a similar habitat.

Paleontological History

The earliest members of the family Harpidae belong to the genus *Eocithara*, of which eleven nominate species (one species has three subspecies) are known, and which has been found in Tertiary deposits from the Upper Paleocene to the Middle Miocene. The oldest species is *Eocithara morgani* Cossmann and Pissaro, 1909, from the Ranikot beds of the Upper Paleocene of Pakistan. A relatively recently discovered specimen

belonging to this genus in Lower Eocene beds of New Zealand is another bit of evidence that at this early period an arm of the Tethys Sea must have extended to New Zealand. We now know, therefore, that by Middle Eocene times the genus *Eocithara* had spread in the east to New Zealand, and to the westward as far as Texas and California. Upper Eocene species are known from Burma and Mississippi.

Regarding the phylogenetic origin of the Harpidae we are still in doubt as to a possible ancestral form, and to spend much time on this problem is to my mind an exercise in futility. Cox has outlined the situation very well when he wrote "Although the apparent great faunal gap between the Cretaceous and the Tertiary has diminished considerably with increased knowledge, it may still be said that we know nothing of the ancestry of most of the new molluscan groups that appeared during the period of intense evolutionary activity which marked the transition from Mesozoic to Cainozoic times . . . each new genus . . . appears more or less suddenly, without any evidence of having evolved gradually from older forms . . . the more we know, the more we are forced to the conclusion how incomplete the record is, and may always remain" (Cox, 1930, pp. 142-143).

If we cannot determine the origins of the Harpidae we can make some conjectures as to the later history of the family. It seems very possible that the family, along with other warm-water genera "first evolved in the Indian Ocean and subsequently migrated westwards" (Cox, loc. cit.). In Middle Eocene times the genus *Eocithara* is found in Texas and as far west as California where it is represented by a subspecies of *E. mutica* of the Paris Basin, as well as by a distinct species. Another species is found in the Upper Eocene of Mississippi.

To the east of India the genus persisted longer than in Europe, where its last representative is found in the Lower Oligocene. In Java a species of *Eocithara* is found in the Miocene, and in the Marshall Islands a fragment assignable to this genus has been found in beds of Upper Miocene age.

From cocitharid stock arose a species found in the Upper Eocene of New Zealand that has been placed in a distinct subgenus, *Maruickara* Laws, 1935. Another species, of quite different aspect but with a parallel origin, is found in the Middle Miocene of southern Australia; this is now placed in the subgenus *Refluharpa* Iredale, 1931.

Meanwhile a distinct group was arising, probably derived from some early cocitharid stock. This was the genus *Harpa*, characterized by a relatively smaller, broadly conical spire, a greater fusion and extension of the successive expanded upper portions of the outer lip and parietal callus over the preceding whorl, and a thinner, broader, not strongly marginate parietal and columellar callus that is more closely appressed over the ventral surface of the siphonal fasciole. One of the key differential characters is the multispiral, elevated-conical protoconch with peripherally keeled whorls found in *Harpa*; this contrasts with the paucispiral protoconch of *Eocithara* with its somewhat planate apex.

Unfortunately the protoconch of most of the specimens of fossil species assigned to *Harpa* is more or less eroded and thus the characters are not clear. Other characters, however, observed in certain fossil species, such as the nature of the parietal callus and its extension over parts of the penultimate whorl, have induced me to place them in the genus *Harpa* rather than in *Eocithara*.

The oldest recognized species of *Harpa* is *H. myrmia* Olsson of the Lower Oligocene of Peru. Other species are found in the Lower and Middle Miocene of France, Italy, the Caribbean, and Fiji, and in the Pliocene of Japan. From Miocene times onward species now living are represented in the fossil record.

In the Oligocene and Lower Miocene times there arose in southern Australia a stock of small fossil species which are now all placed in the genus *Austroharpa*. These are distinguished from both *Eocithara* and *Harpa* by their paucispiral, bulbous or dome-shaped protoconch. Their phylogenetic origin is unknown, but some of the Middle Miocene and Pliocene species gave rise to the four recent species that now live in the warm-temperature waters of southern Australia.

(Eucithara) = sub-Harpidae
 = sub-Harpidae

List of Recognized Taxa

The daggers (†) preceding the taxa indicate fossil forms.

Family Harpidae Bronn, 1849

GENUS *Eocithara* Fischer, 1883

Subgenus *Eocithara* Fischer, 1883

†*morgani* Cossmann and Pissaro, 1909. Upper Paleocene, Pakistan

†*mutica* Lamarck, 1803. **Type.** Middle Eocene, France

†subsp. *altavillensis* Defrance, 1821. Middle Eocene, France

†subsp. *hilarionis* Gregorio, 1880. Middle Eocene, northern Italy

†subsp. *californica* Vokes, 1937. Middle Eocene, California

†*clarki* Vokes, 1937. Middle Eocene, California

†*triacostata* Risso, 1826. Middle or Upper Eocene, France

†*legans* Deshayes, 1835. Upper Eocene, France

†*jacksonensis* Harris, 1896. Upper Eocene, Mississippi

†*birmanica* Vredenburg, 1923. Upper Eocene, Burma

†*submutica* Orbigny, 1852. Lower Oligocene, France

†*narica* Vredenburg, 1925. Oligocene, Pakistan

†*bellardii* Sacco, 1890. Oligocene, Italy

†*muticaeformis* Martin, 1916. Lower Miocene, Java

Subgenus *Marwickara* Laws, 1935

†*caihaoensis* Laws, 1935. **Type.** Upper Eocene, New Zealand

Subgenus *Refluharpa* Iredale, 1931

†*lamellifera* Tate, 1889. **Type.** Middle Miocene, southern Australia

GENUS *Harpa* Röding, 1798

harpa Linné, 1758. **Type.** Recent, Indo-Pacific

†*tsota* Aoki, 1966. Lower Pliocene, Japan

†*amouretta* Röding, 1798. †Pliocene to Recent, Indo-Pacific

gracilis Broderip and Sowerby, 1829. Recent, Micronesia and Polynesia

articularis Lamarck, 1822. †Upper Miocene to Recent, southwestern Pacific

major Röding, 1798. †Miocene to Recent, Indo-Pacific

davidis Röding, 1798. Recent, eastern Indian Ocean

ventricosa Lamarck, 1816. Recent, western Indian Ocean

costata Linné, 1758. Recent, islands of western Indian Ocean

doris Röding, 1798. Recent, west coast of Africa; Ascension Island

†*broichom* Cossmann, 1899. Lower Miocene, France

†*josephinae* Sacco, 1890. Middle Miocene, Italy

†*americana* Pilsbry, 1922. Middle Miocene, Caribbean

crenata Swainson, 1822. Recent, eastern Pacific

†*myrma* Olsson, 1931. Lower Oligocene, Peru

GENUS *Austroharpa* Finlay, 1931

Subgenus *Austroharpa* Finlay, 1931

†*pulligera* (Tate, 1889). **Type.** Middle Miocene, southern Australia

Subgenus *Palamharpa* Iredale, 1931

exquisita (Iredale, 1931). **Type.** Recent, southeastern Australia

loisae Rehder, 1973. Recent, southern Western Australia

punctata (Verco, 1896). Recent, South Australia

wilsoni Rehder, 1973. Recent, southern Western Australia

†*sulcosa* (Tate, 1889). Middle Miocene, southern Australia

†*tatei* Finlay, 1931. Pliocene, South Australia

†*spirata* (Tate, 1889). Middle Miocene, Southern Australia

†*tenuis* (Tate, 1889). Lower to Middle Miocene, southern Australia

†*abbreviata* (Tate, 1889). Middle Miocene, southern Australia

†*clathrata* (Tate, 1889). Lower Miocene, southern Australia

†*pachycheila* (Tate, 1894). Upper Oligocene, southern Australia

†*cassinoides* (Tate, 1889). Pliocene, southern Australia

Plate 188. *Harpa* from the Indo-Pacific.

Figs. 1, 2. *Harpa ventricosa* Lamarck, 1816. 1, Zanzibar (USNM 597093); 2, Mauritius (USNM 666302).

Figs. 3, 4. *Harpa kajiyamai* Rehder, new species. 3, paratype from the Philippines; 4, holotype, Philippines (Nat. Sci. Mus. Tokyo 41450).

Figs. 5-7. *Harpa articularis* Lamarck, 1822. 5, off Taiwan

(USNM 681738); 6, Cebu, Philippines (USNM 612451); 7, southwest Pacific (Del. Mus. Nat. Hist. 1743).

Figs. 8-11. *Harpa major* Rödning, 1798. 8 and 11, typical form from Cebu, Philippines (USNM 543683) and Okinawa, Ryukyu Ids. (USNM 670380); 9 and 10, dark form or forma *ligata* Menke (Australian Mus. C. 73513) from Melanesia.

Doubtful and erroneously assigned species

Harpa crescentensis Weaver and Palmer, 1922

Range—Middle Eocene of Washington (Crescent formation).

Remarks—This small species, the holotype measuring only 6 mm. in length, does not appear to be a true *Harpa*. The attenuate anterior end of the body whorl (the authors in their original description speak of the "canal moderately elongate") is unlike that found in any species of Harpidae, as is the relatively broad, high spire. Vokes (1937, p. 12, pl. 2, fig. 9) figures a supposed topotype, somewhat larger (9.3 mm.) than the type, which shows the broad high spire but the specimen has a more typically harpid aperture, without any narrowing at the siphonal canal. Possibly two species are involved here.

Synonymy—

1922 *Harpa crescentensis* Weaver and Palmer, Univ. Washington Publ. Geology, vol. 1, p. 40, pl. 11, fig. 21 (Port Crescent, Clallam Co., Washington).

1937 *Harpa? crescentensis* Weaver and Palmer, Jour. Paleont., vol. 11, p. 12, pl. 2, fig. 9.

1942 *Harpa crescentensis* Weaver and Palmer, Univ. Washington Publ. Geology, vol. 5, p. 498, pl. 95, figs. 12, 13.

Harpa dechordata White, 1888

Range—Paleocene of Brazil.

Remarks—This species, with broad rugose folds on only the upper half of the body whorl, has been placed in *Pseudoliva* (Olividae) by Harris (1896, p. 154).

Synonymy—

1888 *Harpa dechordata* White, Arch. Mus. Nac. Rio de Janeiro, vol. 7, p. 136, pl. 13, figs. 7, 8 (Maria Farinha, Pernambuco, Brazil).

1896 *Harpa* [*Pseudoliva*] *dechordata* White, Bull. Amer. Paleont., vol. 1, no. 4, p. 154.

Harpa bellardii var. *madachi* Noszky, 1940

Range—Oligocene of Hungary.

Remarks—This variety seems to me to have very little relationship with the Italian *Ecithara bellardii* Sacco, and probably represents a distinct species. However, the name is based on an internal mold with adhering remains of the shell, is described only very briefly, and from the illustration does not resemble any species in the Harpidae known to me. The ribs, very stout and few in number, do not appear to curve forward at the suture. Without a knowledge of the characters of

the aperture and ventral side of the shell it is impossible to discuss the affinities of this species, and even to be certain it is a member of this family.

Synonymy—

1940 *Harpa bellardii* var. *madachi* Noszky, Ann. Hist.-Nat. Mus. Hungarici. Min.-Geol.-Paleont., vol. 33, p. 34, pl. 2, fig. 11 (near Budapest, Hungary).

Eoharpa sinuosa Stephenson, 1955

Range—Upper Cretaceous of Mississippi and Missouri (Owl Creek formation).

Remarks—Proposed as a new genus in the family Harpidae, *Eoharpa* does not appear to belong in this family. The attenuation of the anterior end into a fairly long canal, the relatively high spire with fairly straight-sided whorls, and the presence of strong tubercles on the parietal and columellar callus are characters not found in any fossil or recent members in the family.

Synonymy—

1955 *Eoharpa sinuosa* Stephenson, U. S. Geol. Survey Prof. Paper 274-E, pp. 131-132, p. 23, figs. 3-6.

Harpa? soriensis Eames, 1952

Range—Eocene of Pakistan

Remarks—From the illustration and description I doubt very much that this species belongs in the Harpidae. It might be assigned to the Buccinidae s. lat.

Synonymy—

1952 *Harpa? soriensis* Eames, Phil. Trans. Royal Soc. London, Series B, no. 631, vol. 236, p. 106, pl. 4, fig. 91 (Zinda Pir section, Kohat District, Pakistan).

Harpa trimmeri Fleming, 1828

Range—Lower Eocene of London, England.

Remarks—According to information kindly furnished me by C. P. Nuttall and J. Cooper of the British Museum (Natural History), this species is very probably the volutid *Athleta tricornata* (J. Sowerby, 1840) from the London Clay, Lower Eocene.

Synonymy—

1828 *Harpa trimmeri* Fleming, History of British Animals, p. 342 (probably London Clay at Brentford).

Harpa neozelanica Suter, 1917

Range—Middle Eocene (Bortonian) of New Zealand (Waihaeo).

Remarks—Marwick (1934) suggests that Suter's type represents a gerontic specimen of what Su-

ter in the same paper described as *Tudicla neozelanica*. The latter species Marwick placed in his new genus *Fascioplex* (op. cit. p. 15) in the Fasciolaridae.

Synonymy—

- 1917 *Harpa* (*Ecithara*) *neozelanica* Suter, New Zealand Geol. Survey, Paleont. Bulletin No. 5, p. 43, pl. 5, fig. 11 (Waiaho River, South Canterbury, New Zealand).
 1934 *Fascioplex neozelanica* (Suter), Marwick, Proc. Malac. Soc. London, vol. 21, p. 16, pl. 1, fig. 8 (*Harpa* (*Ecithara*) *neozelanica* Suter listed as synonymy).
 1966 *Fascioplex neozelanicus* (Suter), Fleming, New Zealand Dept. Sci. and Industr. Res., Bull. 173, p. 316, pl. 109, fig. 1341. (*Harpa neozelanica* Suter listed as synonym in explanation of plate).

Institutional Abbreviations

The following abbreviations for institutions are used in this paper:

- AMN—American Museum of Natural History, New York.
 AMS—Australian Museum, Sydney.
 ANSP—Academy of Natural Sciences, Philadelphia.
 AUCK—Auckland Institute and Museum, New Zealand.
 BM—British Museum (Natural History), London.
 BPBM—Bernice P. Bishop Museum, Honolulu.
 CAS—California Academy of Sciences, San Francisco.
 DMNH—Delaware Museum of Natural History, Greenville.
 MCZ—Museum of Comparative Zoology, Cambridge, Massachusetts.
 MHNG—Museum d'Histoire Naturelle, Geneva.
 MNHP—Museum National d'Histoire Naturelle, Paris.
 NMV—National Museum of Victoria, Melbourne.
 RNHL—Rijksmuseum van Natuurlijke Historie, Leiden.
 SAM—South Australian Museum, Adelaide.
 TAU—Tel Aviv University, Tel Aviv.
 USGS—U. S. Geological Survey, Washington.
 USNM—National Museum of Natural History, Washington.
 WAM—Western Australian Museum, Perth.
 ZMC—Zoological Museum, Copenhagen.

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Finally, for advising me on numerous questions and problems brought to them, and for help in many ways I am indebted to the following colleagues at the National Museum of Natural History—H. S. Ladd, J. P. E. Morrison, J. Rosewater, and W. P. Woodring.

Key to the genera and subgenera of the family Harpidae

- A Protoconch multispiral (3 to 5 whorls), elevated-conical, whorls with a peripheral keel *Harpa*
- AA Protoconch paucispiral (2¼ to 3 whorls), broadly conical or bulbous, whorls without peripheral keel B
- B Protoconch mamillate with planate apex, and 2¼ to 3 convex whorls, suture impressed C
- BB Protoconch bulbous or dome-shaped, with 2 or fewer adpressed whorls D
- C Aperture length less than 60% of total length *Marwickara*
- CC Aperture length more than 70% of total length E
- D Protoconch bulbous, with large, inflated initial whorl *Austroharpa*
- DD Protoconch dome-shaped, with small initial whorl *Palamharpa*
- E Axial ribs widely separated, less than 18, parietal callus strong with marginate edge; protoconch small, rather turreted *Eocithara*
- EE Axial ribs crowded, more than 35; parietal callus thin, without sharp edge; protoconch large, broader than high *Refluharpa*

Plate 189, *Harpa* from the Eastern Pacific,
Indo-Pacific and Eastern Atlantic

(Opposite page)

Figs. 1, 2. *Harpa crenata* Swainson, 1822. 1, Mazatlan, Sonora, Mexico (ANSP 250671); 2, Mulege Bay, Baja California, Mexico (USNM 12509).

Figs. 3-5. *Harpa gracilis* Broderip and Sowerby, 1829. 3, Vahitahi, Tuamotu Ids. (USNM 613243); 4, Raroia, Tuamotu Ids. (USNM 698318); 5, Papeete, Tahiti (Del. Mus. Nat. Hist. 12830).

Figs. 6-8. *Harpa amouretta* Röding, 1798, typical form. 6, 7 Siasi, Sulu Archipelago, Philippines (Del. Mus. Nat. Hist. 5185); 8, Ryukyu Ids. (USNM 670470).

Figs. 9-11. *Harpa amouretta* Röding, 1798, forma *crassa* Krauss, 1848. 9, Zanzibar (USNM 597117); 10, Cebu Id., Philippines (Del. Mus. Nat. Hist. 12828). 11, Mogadiseio, Somalia (USNM 673893).

Figs. 12-14. *Harpa doris* Röding, 1798. 12 and 13, Senegal (ANSP 180950); 14, Cape Verde Islands (Del. Mus. Nat. Hist. 122249).

Figs. 15, 16. *Harpa doris* Röding, 1798. Broad, heavy form. Ascension Island, South Atlantic. 15, (MCZ 278591); 16, (MCZ 232221).



Plate 189, *Harpa* from the Eastern Pacific,
Indo-Pacific and Eastern Atlantic
(*explanation on opposite page*)

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Family Harpidae Bronn, 1849

Genus Eocithara Fischer, 1883

This extinct genus comprises a group of species known only from the Lower Eocene to the Upper Miocene. They are all small, reaching a maximum length of 39 mm. (about 1½ inches), and have a paucispiral protoconch that is bluntly mammillate to broadly conical, with convex whorls and impressed sutures. The axial ribs or varices may be few (about twelve) or numerous and crowded and may be lamellar and sometimes slightly reflected or ridgelike and triangular in cross-section; the ribs at the shoulder are without spines, angular, or occasionally weakly spinose.

The genus *Eocithara sensu lato* comprises three subgenera: *Eocithara sensu stricto*, *Marwickara* Laws, 1935 and *Refluharpa* Iredale, 1931. These subgenera have been summarily differentiated in the key given above.

The basic character differentiating *Eocithara* from the other genera of Harpidae is the paucispiral protoconch with a planate apex, and with the nuclear whorls without a peripheral keel but with impressed sutures. From *Harpa* it differs also in the generally much smaller size of its species, in the forwardly expanded upper part of the successive outer lips of the body whorl not fusing and covering most of the preceding whorl, and in the outer edge of the parietal callus being distinctly marginate. The genus *Austroharpa* differs in possessing a paucispiral, bulbous or dome-shaped protoconch, and in the forward curving upper part of the varices not prominent, or only slightly visible at the suture.

Subgenus Eocithara Fischer, 1883

Type: *Harpa mutica* Lamarck, 1803

The members of the typical subgenus are marked by their rather broadly ovate shape, short conical spire, well-developed parietal callus that is marginate at its outer edge often leaving exposed a pseudumbilical chink at the siphonal fasciole.

The ten described species and subspecies assigned to *Eocithara s.s.* occur in deposits of

Lower Eocene to Lower Miocene age from California and Mississippi through France and Northern Italy to Burma, Java, and Fiji. A fragment apparently assignable to this subgenus was found in deposits of Upper Miocene age in the Marshall Islands.

Synonymy—

1881 *Harpa* Lamarck, Jousseume, Bull. Soc. Zool. France, vol. 5: Proc.-Verb., p. XXXVIII. Not *Harpa* Lamarck 1799, nor *Harpa* Röding, 1798.

1883 *Eocithara* Fischer, Man. de Conch., p. 601 (type by monotypy: *Harpa mutica* Lamarck.)

Eocithara morgani (Cossmann and Pissaro, 1909)

(Pl. 191)

Range—Upper Paleocene of Pakistan (Upper Ranikot).

Remarks—This, the earliest known species unquestionably assigned to the family, is undoubtedly closely related to *E. mutica* Lamarck from the Middle Eocene of France, in the ancestral line of which *E. morgani* may be considered to stand. A copy of the original description follows:

"Size moderate, shape depressed; spire conical, terminated by a smooth papillate protoconch of one whorl and a half; seven spire whorls, convex, depressed, separated by deep sutures, ornamented with thin, lamellar, distant ribs, slightly spinose posteriorly, regularly coinciding in successive whorls, decussated on the earlier whorls



Plate 190. *Eocithara mutica* (Lamarck). Protoconch of specimen from Chaussy, France; Middle Eocene. USNM 646907. X 10.

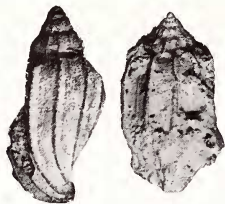


Plate 191. *Eocithara morgani* (Cossmann & Pissaro, 1909). Lower Eocene of Pakistan. Left-hand figure 33.9 mm. in length; right-hand figure 19.6 mm. (from Cossmann & Pissaro, 1909, pl. 2, fig. 25; pl. 3, fig. 24).

only, by a few spiral threads which are so thin as to be scarcely visible. Body-whorl very large, constituting almost the entire shell, excavated at its base. The axial lamellae persist upon the body-whorl up to its anterior region, while two or three axial threads, very thin, and of very slight relief, are intercalated amongst them, without spiral striations. It is only towards the base, in the excavated portion neighbouring the neck, that one distinguished some very fine spiral threads."

A plaster cast of the holotype, forwarded to me by M. V. A. Sastry of the Geological Survey of India, measures 33.9 mm. in length and 19.0 mm. in width.

The type locality is given by Cossmann and Pissaro as north of Leilan coal pit, Sind, Pakistan, from the upper beds of zone 3. Vredenburg (1928, p. 35) states that this is erroneous, and



Plate 192. *Eocithara mutica* (Lamarck, 1807) Middle Eocene, Chaussy, France. USNM 646907 29.7 mm.

that the two syntypes are from the uppermost beds (zone 4) of the Ranikot at Jhirak, Sind.

Vredenburg (1928, pp. 33-35) gives a more extended and detailed description of this species.

Synonymy—

- 1909 *Harpa morgani* Cossmann and Pissaro, Mem. Geol. Survey India, Paleontologia Indica, n. s., vol. 3, mem. 1, p. 22, pl. 2, fig. 25, pl. 3, fig. 24.
 1923 *Harpa (Eocithara) morgani* Cossmann and Pissaro, Vredenburg, Rec. Geol. Survey India, Paleontologia Indica, vol. 10, mem. 4, pp. 33-35 (Jhirak, Sind, Pakistan, Upper Ranikot).

Eocithara mutica (Lamarck, 1803)

(Pl. 192)

Range—Middle Eocene of France (Lutetian of Paris Basin).

Remarks—The type-species of *Eocithara* is a rather distinctive shell, and although not common in collections is the best known of all fossil species of the family Harpidae. The following description is based on five specimens in the collections of the National Museum of Natural History.

The species that Deshayes depicts for *Harpa mutica* Lamarck (Deshayes, 1824, pl. 86, figs. 14, 15) represents his "Var. a" (Deshayes, idem, p. 642), which he describes as being larger, more inflated, and with more distant ribs. This is quite distinct from the typical *mutica* Lamarck, and may be the *E. raricostata* Risso discussed below.

Description—Adult shell rather small, 24 to 39 mm. (1 to 1½ inches) in length, ovate, with a conical spire. Protoconch of 2¼ to 2½ whorls, with flattened apex and impressed suture, the whorls convex and smooth. Postnuclear whorls of spire convex, with sharp, lamellar, rather widely separated axial ribs that curve forward in the upper third of their length; in the body whorl this forward-curved upper end of each rib is adnate to the suture but does not reach the succeeding rib. Between the axial ribs there are strong, somewhat distant, spiral striae, subequal in strength, and crossed by distant, axial growth lines; below the suture, on the subsutural ramp, the spiral lines are fewer and more distantly spaced. The body whorl is gently convex, occasionally showing a distinct angulation at the shoulder, in which cases the spiral sculpture on the subsutural ramp is obscure or absent; axial ribs 12 to 14 in number, lamellar, occasionally slightly reflected, especially near the aperture, at the shoulder sometimes noticeably angulate; in the intercostal spaces the distantly spaced growth wrinkles are prominent, crossing the strong spiral sculpture and giving the

surface a netted appearance; siphonal fasciole strong, crossed by the strongly lamellose anterior end of the axial ribs. Aperture narrowly ovate, outer lip gently curved, smooth, reflected; inner lip forming a narrow callus on the parietal and columellar areas, with a conspicuous, slightly thickened margin, that in its anterior half is rather erect, and leaves exposed the pseudumbilical chink.

Measurements (mm.)—

| length | width | no. whorls | |
|--------|---------|------------|----------------------|
| 29.7 | 18.0 | 6.5 | Chaussy |
| 39.0 | 29.0(?) | | original description |
| 39.0* | 24.9* | | Chaussy |

*Measured from figure in Cossmann and Pissaro, 1913

Synonymy—

1803 *Harpa mutica* Lamarck, Ann. Mus. Hist. Nat. Paris, vol. 2, pt. 2, p. 167; 1805, Lamarck, Ann. Mus. Hist. Nat. Paris, vol. 6, p. 227, pl. 44, fig. 14; 1824, Deshayes, Descr. Coq. Foss. Env. Paris, vol. 2, p. 642 [not pl. 86, figs. 14, 15 which represent Deshayes' var. a]; (Grignon, France).

1853 *Harpa (Eocithara) mutica* Lamarck, Fischer, Manuel Conch., p. 601; 1899, Cossmann, Essais Paléozoich. Comp., pt. 3, pp. 73, 75, fig. 10, pl. 3, figs. 22, 23; 1913, Cossmann and Pissaro, Icon. Compl. Coq. Foss. Eocene Paris, vol. 2, pl. 46, figs. 209-1.

***Eocithara mutica altavillensis* (DeFrance, 1821)**

Range—Middle Eocene of France (Calcaire Grossier of western France).

Remarks—This form, described as a species by DeFrance, has been declared to be merely a variety of *Eocithara mutica* (Lamarck) that is smooth between the ribs (Deshayes, 1865, p. 524). Without

seeing a specimen or figure, or even a description of this form I am unable to determine whether it should be ranked as a subspecies or a distinct species; for the present, therefore I am leaving it as a subspecies.

Synonymy—

1821 *Harpa altavillensis* DeFrance, Dict. Sciences Naturelles, vol. 20, p. 303 (Hauteville, Dept. de la Manche).

1865 *Harpa mutica* var. *altavillensis* DeFrance, Deshayes, Descr. Anim. sans Vert Bassin de Paris, vol. 3, p. 524.

***Eocithara mutica californiensis* (Vokes, 1937)**

(Pl. 193)

Range—Middle Eocene of California (Domengine stage).

Remarks—Vokes is undoubtedly correct in considering this a subspecies of the *Harpa mutica* Lamarck from the Calcaire Grossier of France. The differences mentioned by Vokes are slight—one less axial rib on the body whorl and the presence of spiral sculpture on the subsutural ramp.

Description (copied from Vokes, 1937)—Types: Holotype, Univ. California Mus. Paleont. 30438; paratypes, U.C.M.P. 30439, 30440; loc. 3296, Lljajas formation, Aliso Canyon, Ventura County, California.

Dimensions: Holotype, length 26.4 mm., diameter (crushed), 16.2 mm.; paratype 30439, length, 19.8 mm., diameter (crushed), 9.7 mm.; paratype 30440, length (incomplete), 18.2 mm., diameter, 11.2 mm.

Shell of moderate size, subfusiform, globose; nucleus smooth, papillate, of approximately three whorls; post-nuclear whorls five, convex, shouldered, with somewhat appressed sutures, ornamentation consisting of prominent, distant, lamellar axial ribs decreasing in number from 15 to 17 on the first post-nuclear whorl to 10 to 12 on the body whorl; interspaces ornamented with numerous (6 to 15), secondary axial riblets; spiral sculpture of numerous, irregularly spaced primary and secondary riblets, the secondary ribbing tending to extend up on the shoulder of the whorl; aperture more than twice the length of the spire, moderately narrow; outer lip simple, inner lip with a well-developed characteristic callus wash, anterior canal short; base of shell concave, with a well-developed fasciole.

Synonymy—

1936 *Harpa (Eocithara) mutica* n. subsp. Vokes mss., Bull. Geol. Soc. America, vol. 47, p. 871 [nomen nudum].

1937 *Harpa (Eocithara) mutica californiensis* Vokes, Jour. Paleont., vol. 11, p. 11, pl. 2, figs. 2, 4, 6, 8.

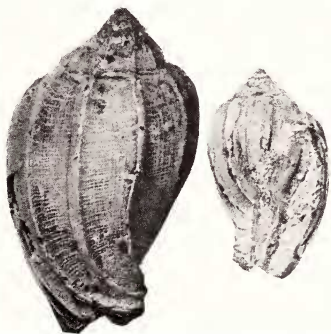


Plate 193. *Eocithara mutica californiensis* (Vokes, 1937). Middle Eocene of California. 26.4 mm. (from Vokes, 1937, pl. 2, figs. 2, 6).

***Eocithara mutica hilarionis*
(Gregorio, 1880)**

(Pl. 194)

Range—Middle Eocene of Northern Italy (Upper Lutetian).

Remarks—This subspecies is very close to the nominal species, and its validity as a distinct taxon is somewhat doubtful. The principal differences according to the author are the smaller number of ribs—10 or 11 rather than the 12 to 14 found in *mutica* s. str.—and stronger cancellate sculpture between the ribs.

Because Gregorio's work is rare and unavailable to most students, I give a free translation of the original diagnosis:

"It is rather common at San Giovanni, although complete specimens are rarely found. It reaches there a fair size: the figured specimen has a length of 35 mm., a width of 23 mm., and a spire angle of 83°; another specimen is almost 33 mm. long. Some characters are present that are different from the form found in the Paris Basin, not enough to make it a distinct species, but sufficient to consider it a well-defined variety. The principal differences are the following: the form is much more oblong than the figure given by the worthy Deshayes [this is *H. mutica* var. *a* Deshayes, possibly the same as *E. varicostata* (Risso, 1826)], but more like that given by Lamarck (p. 40, pl. 44, Mem. sur les foss. des environs de Paris); ribs of the body whorl usually ten or eleven; between them an elegant, net-like, cancellate sculpture, which is formed by numerous spiral threads and fewer (about 5), more prominent axial ones that resemble sometimes little riblets. Neither Deshayes nor Lamarck note this difference, but the figure of the latter author distinctly shows the axials while the spirals are lacking; evidence of the supremacy of the former over the latter. The number of whorls is six or seven; the first smooth,

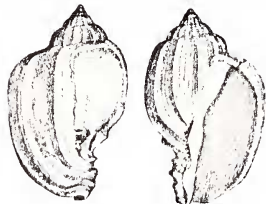


Plate 194. *Eocithara mutica hilarionis* Gregorio, 1880. Middle Eocene of Italy. Holotype, 35 mm. in length (from Gregorio, 1880, pl. 5, figs. 43a, b).

submamillate; the last whorl large, but not as globose as that figured in the work of Deshayes in which the posterior convexity seems to cover part of the spire. This species seems to have been found at Croce Grande by Bayan, and listed in his Catalogue as *Harpa* cf. *mutica* Lamarck."

Synonymy—

1880 *Harpa mutica* var. *Hilarionis* Gregorio, Fauna di S. Giovanni Ilarione (Parisiense). Parte I. Cefalopodi e Gastropodi, p. 42, pl. 5, figs. 43a, b.

***Eocithara clarki* (Vokes, 1937)**

(Pl. 195)

Range—Middle Eocene of California (Domengine state).

Remarks—This species is more narrow than any other known species of *Eocithara*, with a higher spire, and without any secondary spiral sculpture.

Description (copied from Vokes, 1937)—Holotype: Univ. California Mus. Paleont. 15792; loc. A-1165, Big Tar Canyon, south of Coalinga, California; Domengine formation.

Dimensions: Length, 26.4 mm.; diameter, 14.6 mm.

Shell of moderate size, thin, subfusiform; spire high, of five post-nuclear whorls, ornamented with slightly sinuous, lamellar axial ribs separated by broad interspaces marked by five narrow, secondary axial threads and numerous spiral ribs of equal strength, separated by interspaces about twice the width of the spiral; with 13 axial lamellae on the third post-nuclear whorl, 14 on the penultimate, and 16 on the ultimate whorl; whorls shouldered but slightly, sutured appressed, distinct; aperture twice the length of the spire, nar-



Plate 195. *Eocithara clarki* (Vokes, 1937). Middle Eocene of California. 26.4 mm. (from Vokes, 1937, pl. 2, figs. 5, 7).

row; outer lip simple, inner lip with a characteristic callus wash; base of the shell concave, recurved to a strong fasciole ornamented with the axial lamellae.

Synonymy—

1937 *Harpa (Eocithara) clarki* Vokes, Jour. Paleont., vol. 11, p. 11, pl. 2, figs. 5, 7.

***Eocithara raricostata* (Risso, 1826)**

Range—Upper or Middle Eocene of southern France (Alpes Maritimes).

Remarks—This species, very briefly described and unfigured, has been ignored by all later workers. Judging from the short diagnosis, it is characterized by its broad inflated shape and distant axial ribs. It may be that this is the same as the *Harpa mutica* var. *a* of Deshayes (1824, Descr. Coq. Foss. Env. Paris, vol. 2, p. 642, pl. 86, figs. 14, 15) which has the same characteristics, and was found at Parnes in the Paris Basin. Only an examination of the type, if it exists, can determine its relationship with the other known Eocene species.

Synonymy—

1826 *Harpa raricostata* Risso, Hist. Nat. Europe Merid., vol. 4, p. 180 ("Calcaire grossier de nos montagnes").

***Eocithara elegans* (Deshayes, 1835)**

(Pl. 196)

Range—Upper Eocene of France (Auversian of Paris and Nantes Basins).

Remarks—This species is somewhat less inflated than *E. mutica* (Lam.), and is described as possessing a sharper subsutural angle on the body whorl. The figures, however, given by Cossmann and Pissarro (1913, pl. 46, figs. 209-2) show a shell

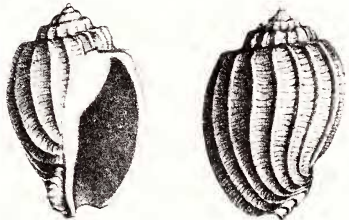


Plate 196. *Eocithara elegans* (Deshayes, 1835). Upper Eocene of France. X 1. (from Deshayes, 1835, pl. 86, figs. 16, 17.

with a rather rounded subsutural shoulder. The spiral sculpture is stronger than in *E. mutica*. *E. elegans* shows some relationship with *E. submutica* Orb.

Description (freely translated from original diagnosis)—This *Harpa* is ovate-oblong, a little more cylindrical than the preceding species [*H. mutica* Lam.]; its spire is short: with six very narrow [= low] whorls of which the last are flattened above. There are thirteen or fourteen longitudinal ribs on the last whorl; these ribs are thicker than in the preceding species, and they are elongated a little in their upper part, as in *Harpa nobilis*. The intervals between the ribs show rather strong distant, unequal transverse striae, a finer one being situated between the stronger ones. These striae form an elegant network with other regular and much finer longitudinal ones. The aperture is proportionately larger than in the other species; the left border is much more narrow, especially at the base of the columella where it leaves uncovered the oblique and scaly fasciole which ends at the terminal notch of the aperture.

The largest specimen that we know of this rare and precious species is 33 mm. long and 20 mm. wide.

Synonymy—

1835 *Harpa elegans* Deshayes, Descr. Coq. Foss. Env. Paris, vol. 2, p. 643, pl. 86, figs. 16-18; 1844, Deshayes, Hist. Nat. An. s. Vert., Ed. 2, vol. 10, p. 134 (Valmondois, France).

1913 *Harpa (Eocithara) elegans*, Cossmann and Pissarro, Icon. Compl. Coq. Foss. Eocene Env. Paris, vol. 2, pl. 46, fig. 209-2.

***Eocithara jacksonensis* (Harris, 1896)**

(Pl. 197)

Range—Upper Eocene of Mississippi (Jackson formation).

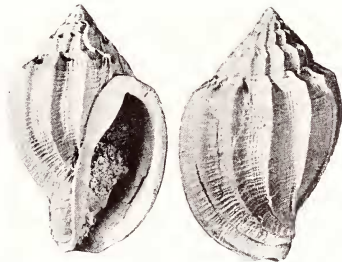


Plate 197. *Eocithara jacksonensis* (Harris, 1896). Upper Eocene of Mississippi. 29.5 mm. (from Harris and Palmer, 1947, pl. 56, figs. 19, 20).

Remarks—This species is a typical member of the genus *Ecithara*. The ribs are fewer in number and heavier than in *E. mutica* (Lamarck), with the intercostal sculpture more pronounced. I have seen two rather poor specimens of this species in the collection of the National Museum of Natural History, of which one measures 31 mm. in length and 18 mm. in width. The holotype measures: length, 31.5 mm.; width 18.7 mm.

Description (copied from Harris, 1896)—“Size and general form as indicated by the figure; volutions 8; 1 and 2 very minute, smooth; 3 much larger, smooth; 4 somewhat larger than 3, showing vertical costae in its first half, then assuming the characteristic markings of the remaining whorls; costae on the body-whorl nine in number, somewhat deflected below the suture as in *Drillia*; between the costae the shell is finely cancellated with a network of raised lines; anterior canal slightly larger than usual for the genus. Locality, Jackson, Miss.”

Synonymy—

- 1896 *Harpa jacksonensis* Harris, Proc. Acad. Nat. Sci. Philadelphia, vol. 48, p. 472, pl. 18, fig. 10.
 1947 *Harpa (Ecithara) jacksonensis* Harris, Harris and Palmer, Bull. American Paleont., vol. 30, no. 117, p. 397, pl. 56, figs. 19, 20.

***Ecithara birmanica* (Vredenburg, 1923)**

(Pl. 198)

Range—Upper Eocene of Burma (Yaw stage).

Remarks—This species, very briefly described by the author, is based on an incomplete specimen. A plaster cast of the holotype, kindly sent to the National Museum of Natural History by M. V. A. Sastry of the Geological Survey of India, measures 19.1 mm. in length and 12.0 mm. in width. The type was collected at Thetkeygin, Burma.

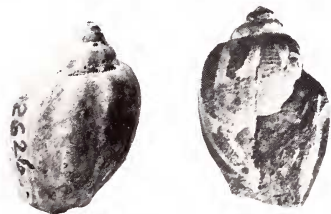


Plate 198. *Ecithara birmanica* (Vredenburg, 1923). Upper Eocene of Burma. 19.1 mm. left-hand figure, plastercast of holotype; right-hand figure from Vredenburg, 1923, pl. 14, fig. 6.

Description (copied from Vredenburg, 1923)—“Although the solitary available specimen is very incomplete, its distinct characteristics make it worthy of record. It is very closely related to *Harpa mutica* Lamk. of the Middle Eocene of the Paris region, from which it is distinguished by its smaller size and the much more delicate intercostal reticulation. The latter character distinguishes it still more decidedly from *Harpa Morgani* C. and P. occurring in the Lower Eocene of Sind. Compared with *Harpa narica* Vred. from the Oligocene of Sind, the Burmese shell is smaller, with a relatively taller spire and with wider-spaced axial lamellae.”

Synonymy—

- 1923 *Harpa (Ecithara) birmanica* Vredenburg, Rec. Geol. Survey India, vol. 54, p. 252, pl. 14, fig. 6 (Thetkeygin, Burma).

***Ecithara submutica* (Orbigny, 1852)**

(Pl. 199)

Range—Lower Oligocene of southern France (Dax, Landes).

Remarks—I have been unable to find a description of this species which is based on a name accompanying a pair of figures. These original figures show a great resemblance to the figures for *E. elegans* (Deshayes) from the Upper Eocene of the Paris Basin. I have found no references to this species later than that by Cossmann (1899, p. 76) who assigns it to the Tongrian (lowermost Oligocene of Upper Eocene); some later workers place the beds whence this species is supposed to come in the Stampian, or Middle Oligocene.

Synonymy—

- 1845 *Harpa mutica* Lamarck, Grateloup, Conch. Foss. Tert. Bassin Adour, vol. 1, Atlas, 1840-1845, suppl. pl. 1, figs. 21, 22 (Dax, Landes, France).

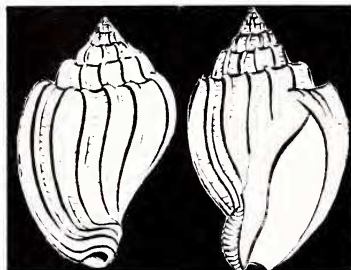


Plate 199. *Ecithara submutica* (Orbigny, 1852). Lower Oligocene of France. X 2. (from Grateloup, 1845, pl. 1, figs. 21, 22).

1852 *Harpa submutica* Orbigny, Prodr. Paléont., vol. 3, p. 17.
New name for *H. mutica* Grat., 1845, not Lamarck, 1803.

1899 *Harpa (Eocithara) submutica* Orbigny, Cossmann, Essais Paléoconch. Comp., pt. 3, p. 76.

Eocithara narica (Vredenburg, 1925)

(Pl. 200)

Range—Oligocene of Pakistan (Nari formation).

Remarks—The figures given by Vredenburg are poor, but I have been able to examine plaster casts of the syntypes of this species. These together with his lengthy description suggest that *narica* has some resemblance to certain species of *Harpa*, especially in the ovate shape of the body whorl without a shoulder angulation, and in the apparent junction of the forward curving upper ends of the successive axial ribs. Indeed, Vredenburg suggests that this species may represent an ancestral form of *Harpa conoidalis* (= *major* Röding). Nevertheless, I am retaining this species in *Eocithara* because of the restricted and marginate parietal and columellar callus, the uncertainty over the nature of the protoconch, and because of the age of the beds in which the species is found.

Description (abbreviated from the original description)—The elongate-ovoid shell has a low, broadly conical spire, the body whorl measuring nine-tenths of the total length. The small eroded protoconch is followed by three and a half convex whorls, the sutures of which are covered by the junction of the forward curving upper ends of the successive axial ribs. These number from 15 to 16 on the spire whorls, and from 14 to 15 on the body whorl, and show a slight spinosity at the rounded shoulder of the whorls. Between the ribs is a delicate network of fine axial and spiral threads. The parietal callus is conspicuously margined by a



Plate 200. *Eocithara narica* (Vredenburg, 1925) Oligocene of Pakistan. 29.0 mm. Plastocast of syntype, USNM.

low, raised edge, and the rectilinear edge of the columellar callus is slightly raised at the pseudumbilical chink on the inner side of the siphonal fasciole.

Measurements (in mm.)—

| | | |
|----------------------|------|------|
| Height | 29.3 | 41.0 |
| Diameter | 17.0 | 24.0 |
| Height of spire | 5.4 | 6.5 |
| Height of body whorl | 26.5 | 38.5 |

Synonymy—

1925 *Harpa (Eocithara) narica* Vredenburg, Mem. Geol. Survey India, vol. 50, p. 122, pl. 1, fig. 16, pl. 2, fig. 6 (Bhagothoro Hill, Sind, Pakistan).

Eocithara bellardii (Sacco, 1890)

(Pl. 201)

Range—Oligocene of northern Italy.

Remarks—Although the brief diagnosis (copied in free translation below) does not mention any characters that assist us in determining whether this species is an *Eocithara* or a *Harpa*, the illustration given by Sacco does show the narrow parietal and columellar callus, the strongly angulate body whorl, and ribs that are apparently not strongly curved forward at the sutural margin. For these reasons I am placing the species in the genus *Eocithara*.

Description (from Sacco, 1890)—Shell of medium size, oblong ovate. Spire fairly high. Whorls about six, with heavy, somewhat rounded, very elevated longitudinal ribs; 12-13 subarcuate ribs in last whorl, which generally alternate with the ribs of the penultimate whorl. Surface between the ribs sculptured with numerous very fine transverse striae. Aperture subfusiform. Outer lip slightly thickened. Columella subumbilicate. Siphon somewhat elongate. Height 30 mm., width 18 mm.

Synonymy—

1890 *Harpa bellardii* Sacco, Moll. Terr. Terz. Piemonte Liguria, pt. 7, p. 9, pl. 1, figs. 1a, 1b (Tongrian of Cassinelle, Dego, Monfese).

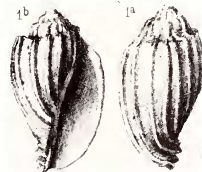


Plate 201. *Eocithara bellardii* (Sacco, 1890). Oligocene of northern Italy. 30 mm. (from Sacco, 1890, pl. 1, figs. 1a, 1b).

***Eocithara muticaeformis* (Martin, 1916)**

(Pl. 202)

Range—Lower Miocene of Java (Gunung Spolong, West Progo Mountains).

Remarks—This species appears to be the latest representative of *Eocithara*, with which it agrees, as Martin points out, in the nature of the parietal callus, the umbilical chink, and the character of the junction of the ribs at the suture. It is beginning to show some relationship with species of *Harpa* in that the outer edge of the parietal callus is thin and is not sharply margined at the outer edge.

Description (freely translated from original)—Shell ovate, somewhat inflated, anteriorly attenuate. The protoconch button-shaped, consisting of two small smooth whorls, the intermediate whorls strongly convex, with high, narrow, axially oriented, slightly curved ribs which in the early whorls develop a bluntly angulate point near the suture. That makes it appear as if a spirally oriented angulation, actually absent, were present [on the body whorl]. Between the distant ribs the surface is covered with fine spiral ridges; they are also separated and number up to six.

The body whorl has fourteen ribs which are curved forward at the suture which they almost cover; a spiral sculpture similar to that on the spire whorls, is present only on the sutural ramp.

The columella is slightly concave in the middle; the inner lip very thin but bordered in its anterior half by a definite furrow, and with the margin distinctly erect over the weakly indicated umbilical chink. The latter is surrounded by a strong spiral fasciole conforming to the siphonal canal, and over which the axial ribs continue in undiminished strength in a sickle-like curve. The outer lip is missing. Length 20 mm.

***Synonymy*—**

1916 *Harpa* (*Eocithara*) *muticaeformis* Martin, Samml. Geol. Reichs-Museums Leiden, N.F., vol. 2, pt. 6, p. 231, pl. 1, figs. 15, 15a (Gunung Spolong, West Progo Mts., Java).

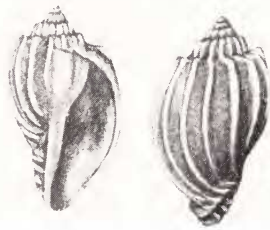


Plate 202. *Eocithara muticaeformis* (Martin, 1916). Lower Miocene of Java. 20 mm. (from Martin, 1916, pl. 1, figs. 15, 15a).

Eocithara species

(Pl. 203)

Range—Lower Eocene (Mangaorapan stage) of New Zealand.

Remarks—This specimen is of interest as it represents the second oldest known species of the Harpidae, and also because it shows the wide range that *Eocithara* had in Lower and Middle Eocene times, throughout the extent of the Tethys Sea, from California, across Europe and India, to New Zealand.

Although new species have been described from poorer specimens than this one, it is inadvisable to give this single specimen a name. I am merely putting it on record to fill out the distributional picture of the genus. The figures adequately show that the characters of the shape of shell and of the ribs appear to be those of a typical *Eocithara*. Shell length 27.9 mm., width 15.2 mm.

Locality—Tufts in bed of Whit's Creek, Eyre River District, Canterbury, New Zealand. Collected by J. Gellen, January, 1960.

Age—Mangaorapan stage—equivalent of about upper Ypresian stage; Lower Eocene.

The above information and the photographs were kindly sent me by Dr. Alan Beu of the New Zealand Geological Survey.

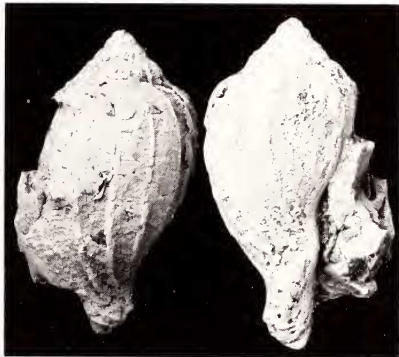


Plate 203. *Eocithara* species. White's Creek, Eyre River District, Canterbury, New Zealand. Lower Eocene (Mangaorapan stage). New Zealand Geological Survey.

Eocithara species

(Pl. 204)

Range—Middle Eocene of Texas (Claiborne formation of easternmost Texas).

Remarks—The fragmentary specimen is presented here to indicate the presence of a species of



Plate 204. *Eocithara* sp. Middle Eocene of Texas. 14 mm. (from Palmer, 1937, pl. 65, fig. 6).

Eocithara in the Middle Eocene of North America. It has wider ribs and somewhat weaker intercostal sculpture than does *E. jacksonensis* (Harris) from the Jackson formation of the Upper Eocene.

The locality is in eastern Sabine Co., Texas, on the edge of the Sabine River, east of Hemphill.

Synonymy—

1937 *Harpa* sp. Palmer, Bull. American Paleontology, vol. 7, no. 32, p. 398, pl. 65, fig. 6 (eastern Sabine Co., Texas).

Eocithara species

Range—Upper Miocene of Eniwetok, Marshall Islands.

Remarks—A fragment 15 mm. long from a drill-hole (No. E-1) on Parry Island, Eniwetok, Marshall Islands, is referred with some doubt to this genus. Only the anterior canal and sinus, the lower portion of the columellar lip, and a part of the body whorl comprising three complete ribs from their procurved upper end to the siphonal fasciole and anterior canal is present.

My assignment of this fragment to *Eocithara* is based on the low, not broadly expanded, procurved end of the ribs, and the nature of the siphonal fasciole—strongly convex on the ventral surface and separated from the lower end of the columellar callus by a deep furrow which suggests a pseudumbilical chink.

The fairly crowded ribs are low, somewhat flattened in their upper portion, with faint, paired color lines visible under magnification. The interspaces show flattened spiral cords crossed by irregular axial growth striae. The crowded microscopic axial striae present in *Harpa major* Röding are absent, and the aspect of the sculpture is generally distinct from that found in the recent species of *Harpa*.

This fragment was found in the portion of a drillhole recovered from 830-840 feet, and is assigned by Ladd (1966, p. 7) to the Upper Miocene.

Further, more complete material is needed to prove the generic allocation. If this placement is correct it is the latest known occurrence for *Eocithara*.

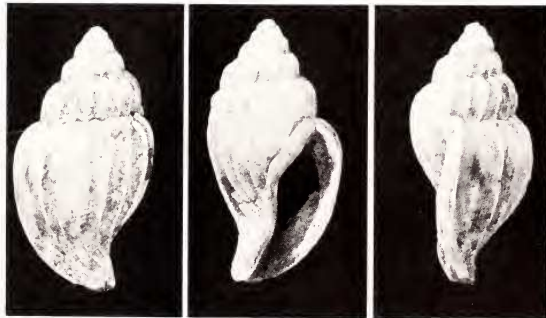
[These occasional blank areas occur between genera and subgenera to permit the insertion of new material and future sections in their proper systematic sequence.]

Eocithara waihaoensis Laws, 1935

(Pl. 205)

Range—Middle Eocene of New Zealand.*Remarks*—The following description is based on the holotype and two fragments kindly sent me on loan by Mr. Walter O. Cernohorsky of the Auckland (New Zealand) Institute and Museum.*Description*—Shell relatively small (23 mm. in length), ovate, with rather high spire (more than one third of total length, as compared with less than one fourth of total length in *Eocithara*). Protoconch somewhat worn but showing rather flattened nuclear whorls. Early post-nuclear whorls also somewhat worn, with fairly strong opisthocline ribs; maximum curvature at shoulder of whorls; ribs numbering twenty in number in penultimate whorl, bluntly angulate in cross-section, not lamellar, with interspaces marked by strong, subequal spiral cords crossed by irregular growth wrinkles; the anterior ends of the ribs form only low ridges on the weakly differentiated siphonal fasciole. Aperture rather narrow, outer lip thickened internally, somewhat reflected, sinuous in profile with a shallow posterior sinus and prosocyrct medially. Inner lip with a distinct and slightly thickened outer margin, which in the type is broken. Siphonal canal moderately long, directed to the left.*Specimens examined*—*Holotype* (Auckland Inst. and Museum): length, 23 mm., width 12.3 mm.; greensands, Waihao Downs, South Canterbury, New Zealand (Bortonian, Middle Eocene). Paratypes: two fragments from same collection.*Synonymy*—1935 *Eocithara (Marwickara) waihaoensis* Laws, Trans. Royal Soc. New Zealand, vol. 65, p. 29, fig. 11 (Waihao Downs, South Canterbury, New Zealand).**Subgenus Marwickara** Laws, 1935*Type*: *Eocithara (Marwickara) waihaoensis* Laws, 1935This subgenus was proposed by Laws for a single species from the Middle Eocene of New Zealand. It had been sent to Dr. J. Marwick for examination whose summary of the differences between the New Zealand species and the type species of *Eocithara* are quoted by Laws.

The principal differences distinguishing this subgenus are the more narrowly ovate shape and higher spire, a protoconch with more flattened, less convex whorls, and a neck and anterior canal that is somewhat twisted to the left. The parietal "denticle" seen on the parietal wall about a third of the distance down from the posterior angle with the outer lip, with a lower obscure swelling below it, may be due merely to an irregularity covered over by the parietal wall.

Synonymy—1935 *Marwickara* Laws, Trans. Royal Soc. New Zealand, vol. 65, p. 28 (Type by original designation: *Marwickara waihaoensis* Laws).Plate 205. *Eocithara (Marwickara) waihaoensis* Laws, 1935. Holotype, Waihao Downs, South Canterbury, New Zealand;

Middle Eocene. 23 mm. Auckland Institute and Museum.

[These occasional blank areas occur between genera and subgenera to permit the insertion of new material and future sections in their proper systematic sequence.]

Subgenus *Refluharpa* Iredale, 1931

Type: *Harpa lamellifera* Tate, 1889

This subgenus contains only one species, *E. (Refluharpa) lamellifera* Tate from the Middle Miocene of Victoria. Iredale proposed the genus *Refluharpa* for this species, which Finlay in the same year had placed in *Eocithara*. Cotton and Woods (1933, pp. 45, 47) made *Refluharpa* a synonym of *Eocithara* because of the similarity of the protoconch.

However, the protoconch of *E. lamellifera* is considerably larger than that of *E. mutica* Lamarck; the maximum diameter of the protoconch of a specimen of the former being more than twice as great as that of an example of *E. mutica*; the number of whorls is generally greater $2\frac{3}{4}$ to 3 as opposed to $2\frac{1}{4}$ in *mutica*; the apex is more planate with the suture more deeply impressed; the parietal callus is not strongly marginate but is thin and evanescent near its outer edge.

These differences plus the later age of *E. lamellifera*, induce me to retain the species in a distinct subgenus.

Synonymy—

1931 *Refluharpa* Iredale, Rec. Austral. Museum, vol. 18, pp. 230, 233 (June 29).

Eocithara lamellifera (Tate, 1889)

(Pl. 206, 207)

Range—Middle Miocene (Balcombian-Bairnsdalian) of Victoria.



Plate 206. *Eocithara (Refluharpa) lamellifera* (Tate). Protoconch of specimen from Muddy Creek, Hamilton, Victoria; Middle Eocene. USNM 646909. X 10.

Remarks—In addition to the differences listed above under the subgenus, this species is marked by the great number of strongly lamellar ribs—more than 35 on the body whorl of a specimen 24.5 mm. in length, by the subsuturally planate whorls, the prominent spiral sculpture between the ribs which is particularly prominent in the penultimate whorl.

It is found in several localities in Victoria—Muddy Creek, Hamilton (the type locality); Balcombe Bay, Port Phillip Bay; near Altona, Port Phillip Bay; Shelford, near mouth of Gellibrand River.

Measurements (mm.)—

| length | width | |
|--------|-------|----------------------|
| 32 | 21.5 | Holotype (SAM-T-698) |
| 36 | 22 | Paratype (SAM-T-698) |
| 24.5 | 16.1 | USNM 646909 |
| 23.6 | 15.9 | USNM |

Synonymy—

1889 *Harpa lamellifera* Tate, Trans. Proc. Rep. Royal Soc. South Australia, vol. 11, p. 149, pl. 6, fig. 2 (lower beds, Muddy Creek, Victoria).

1897 *Harpa (Eocithara) lamellifera* Tate, Harris, Cat. Tertiary Moll., Dept. Geol. British Museum, pt. 1, p. 79, pl. 4, fig. 3 a-b.

1931 *Eocithara lamellifera* Tate, Finlay, Trans. New Zealand Inst., vol. 62, pp. 12, 13 (May 31); 1933, Cotton and Woods, Records South Australian Museum, vol. 5, pp. 45, 47.

1931 *Refluharpa lamellifera* Tate, Iredale, Records Australian Museum, vol. 18, p. 230 (June 29).

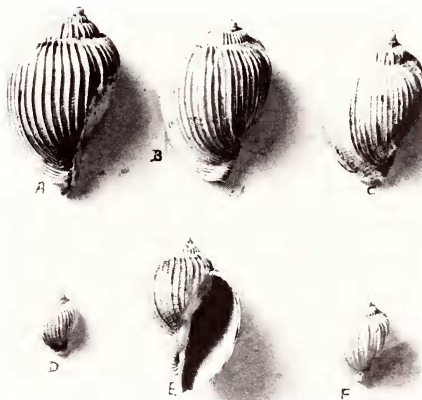


Plate 207. *Eocithara (Refluharpa) lamellifera* (Tate). Holotype (30.5 mm.) and paratypes. South Australian Museum, Tate Colln. 698.

[These occasional blank areas occur between genera and subgenera to permit the insertion of new material and future sections in their proper systematic sequence.]

Genus *Harpa* Röding, 1798

Type: *Harpa harpa* Linné, 1758

The genus *Harpa* comprises nine recent and five fossil species. Seven of the living species are found in the Indo-Pacific region and one each on the West African coast and in the eastern Pacific. The fossil species are found in beds of from Oligocene to Pliocene age.

The shells are characterized by their relatively large body whorl bearing a variable number of axial lamellar or sublamellar ribs, the rather extensive parietal and columellar callus which is not sharply marginate abaperturally, and by the whorls of the spire, especially the penultimate and antepenultimate whorls, being more or less covered by the glaze of the expanded posterior part of the axial ribs. The protoconch is elevated-conic, consisting of from 3 to 5 whorls, usually flesh-pink to purplish red, sometimes whitish in color, with a distinct keel at the periphery, just visible above the suture. The basic color pattern is a banded one, the axial ribs marked with alternating spots of various shades of pink and white, with or without dark horizontal lines, these spots coinciding on successive ribs; the banded effect thus created is strengthened by the irregular, axial, zigzag and festooned dark lines and white spots in the spaces between the ribs, this pattern also being repeated in the successive interspaces, with the adapertural projections of the festoons always coinciding with the white spaces on the axial ribs. In *Harpa costata* much of the color pattern is obscured by the dense axial sculpture. The anterior siphonal notch is rather broad and open, not narrow and somewhat constricted as in *Eocithara*.

Synonymy—

- 1798 *Harpa* Röding, Museum Boltenianum, p. 149 (type by tautonymy: *Harpa harpa* Linné).
 1799 *Harpa* Lamarck, Mem. Soc. Hist. Nat. Paris, vol. 1, p. 71 (type by tautonymy: *Harpa harpa* Linné).
 1806 *Harpalis* Link, Besch. Nat.-Sammlung Univ. Rostock, pt. 3, p. 114 (type here designated: *Harpa major* Lamarck).
 1815 *Harparia* Rafinesque, Analyse de la Nature, p. 145. New name for *Harpa* Lamarck, 1799.
 1934 *Lyra* Griffith and Pidgeon, Cuvier's Animal Kingdom, vol. 12, p. 234. *Nomen nudum*.
 1881 *Cithara* "Klein" Jousseau, Bull. Soc. Zool. France, vol. 5: Proc.-Verb., p. xxxviii (type here designated: *Harpa harpa* Linné).

Nomenclature—Some authors have credited the name *Harpa* to Walch, 1771, or have cited an earlier usage of the name, namely *Harpa* Pallas, 1774. The first is based on Herrmannsen's citation (Herrmannsen, 1846-47, p. 501), who gives, however, an erroneous reference. On page 113 of volume 2, part 1 (not volume 3, p. 113), Walch discusses the "Harfenschnecken" but without using a Latin name; furthermore, Walch's work is non-binominal.

Pallas in his "Spicilegia Zoologica" used *Harpa nobilis* as a vernacular group name in connection with his description of *Buccinum geversianum* (= *Trophon* g.). As such, in addition to being in the plural form, it is not available as a validly proposed taxon.

Harpa harpa (Linné, 1758)

(Pl. 187, figs. 7-10)

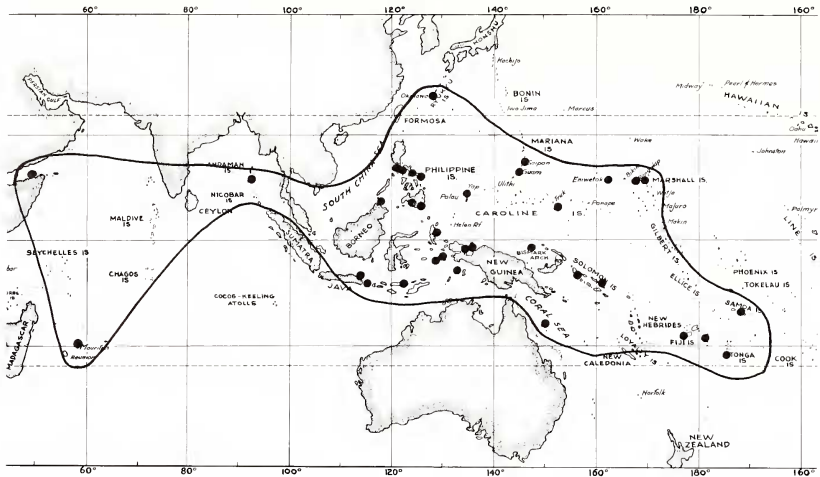
Range—From East Africa to Tonga.

Remarks—This species is characterized by its stout, broadly ovate, markedly shouldered shell, with three separated chestnut blotches on the ventral side, the ribs rather strong, flattened, and marked with many distinct lines arranged in groups; a band of interrupted and irregular blotches of orange brown or reddish brown is generally present about the middle of the body whorl.



Plate 208. Enlarged protoconchs of species of *Harpa*. Fig. 1. *Harpa ventricosa* Lamarck, USNM 7421a. Fig. 2. *Harpa articularis* Lamarck, Off. Tambizen, North Borneo, USNM 666808.

Fig. 2. *Harpa harpa* (Linné), USNM 7421. Fig. 4. *Harpa arenata* Swainson, Mulege Bay, Baja California, Mexico, USNM 12509. (all X 5).

Plate 209. Geographical distribution of *Harpa harpa* (Linné).

The distribution of this species appears to be centered in the Philippines and Indonesia—Abbott's Western Pacific Arc—whence it has spread in to what I term eastern Melanesia, to the Samoan Islands and Tonga, and in the north into northern Micronesia. It is relatively scarce in the Indian Ocean.

Description—Adult shell 42 to 76 mm. (1½ to 3 inches) in length, rather solid, broadly ovate, with a low conical spire, and a last whorl that is bluntly angulate below the shoulder. Nuclear whorls (Pl. 208) 3 to 3½, rosy pink in color, convex, smooth; early postnuclear whorls flattened, smooth on top, made angulate by a spiral ridge at shoulder with one or two below that, and with low, distant, slightly curved axial ribs; the portion of the whorls below the shoulder becomes increasingly covered by the callus that is formed by the successive anterior extensions of the axial ribs that flatten out and cover the adjacent part of the preceding whorl, and finally spread to above the shoulder ridge and over the entire subsutural ramp. Body whorl with a flattened subsutural ramp, markedly though roundly angulate at the shoulder which is marked by strong spines on the ribs; ribs rather broad, crossed by many fine dark lines that are usually present in groups of three or four. Between the ribs the basic color is of various shades of pink and flesh color, marked by whitish pink spiral bands of varying width, the widest just below the shoulder and all with distant chestnut spots; in the

middle of the whorl is a band of irregularly squarish blotches of rust color or red brown that occur generally in every other interspace; the interspaces are marked also by wavy axial stripes of reddish brown. Aperture broadly ovate, rather patulous below, inner lip almost straight, outer lip gently arcuate, thickened within, and subdenticulate along basal half; the interior of outer lip conspicuously marked by dark chestnut at the terminations of the darker spiral bands. The thin glaze covering the ventral side is marked by three distinct reddish brown blotches— anterior, middle, and posterior.

Measurements (mm.)—

| length | width | no. whorls | |
|--------|-------|------------|-------------------------|
| 75.7 | 50.3 | 6½ | large; no data |
| 71.5 | 46.9 | 6½ | large; Okinawa, Ryukyus |
| 65.8 | 43.5 | 6 | average; Guam, Marianas |
| 51.8 | 33.5 | 5½ | small; Okinawa, Ryukyus |

Synonymy—

- 1758 *Buccinum harpa* Linnæus, *Systema Naturæ*, ed. 10, p. 738, no. 400 (ad Benghalæ). Refers to Pottiver, pl. 48, fig. 13; Rumphius, pl. 32, fig. 1; Gualtieri, pl. 29, fig. C. E; and others; 1956, Dodge, *Bull. Amer. Mus. Nat. Hist.*, vol. 111, art. 3, pp. 196-198.
- 1798 *Harpa nobilis* Röding, *Mus. Bolten.*, p. 150; refers to Martini, *Conch. Cab.*, vol. 3, p. 415, pl. 119, fig. 1091 (no locality); 1822, Lamarck, *Hist. Nat. Anim. s. Vert.*, vol. 7, p. 256 (*Océan des Grandes Indes*). 1835, Kiener, *Spec. Gen. Icon. Coq. Viv.*, vol. 8, *Gen. Harpe*, p. 9, pl. 3, fig. 5; 1843, Reeve, *Conch. Icon.*, vol. 1, *Harpa*, pl. 1, figs. 1a, b, c. Not *Harpa nobilis* Lamarck, 1816.
- 1807 *Harpatis nobilis* Link., *Beschreibung Naturalien-Sammlung Univ. Rostock*, p. 114.

1948 *Harpa harpa* (Linné), M. Smith, Triton Helmet and Harp Shells, p. 48, pl. 16, figs. 3, 6; 1963, Shikama, Selected Shells of the World, pl. 77, fig. 1.

Nomenclature—Under the name *Buccinum harpa* Linné included all the species of *Harpa* then known to exist except *H. costata*. His brief diagnosis is very generalized, and his references are illustrative of five Indo-Pacific species. Of the twelve figures to which reference is made six are referable, either with certainty or probability to the shell which until relatively recently was called *Harpa nobilis* Lamarck.

Although Hanley as early as 1855 (*Ipsa Linnaei Conchylia*, p. 215) concluded that the Linnaean name should be restricted to this form, the first person to use Linné's trivial name for this species appears to have been Maxwell Smith in 1948.

Of historical interest is the fact that Schumacher had given the name *musica* to this species; two specimens bearing this manuscript name were found by me in the collection of the Zoological Museum in Copenhagen.

Types—In the Linnean Collection in London I found the three specimens mentioned by Hanley—one each of *Harpa "nobilis, ventricosa and minor."* Of these, the first has the word "harpa" written in pencil in the inside, possibly by James E. Smith (see Dance, 1967, p. 8), and is the one I designate here as lectotype. It measures 52 mm. in length and 33 mm. in width.

Records—SOMALIA: Candala (MCZ). MAURITIUS: Gris Gris Beach (Colln. E. Coucaud). ANDAMANS: N end Invisible Bank, in 75 fms. (ANSP). JAPAN: Okinawa, Ryukyus (ANSP, USNM); (Specimens labeled as from Kii, Japan (ANSP) are probably from the Ryukyus). PHILIPPINES: Calapan, Mindoro (ANSP, MCZ); Boac, Marinduque (DMNH); Ticao (AMNH); Borongan, Samar (ANSP); Cebu City, Cebu (AMNH, ANSP); Tabian, Mindanao; Sarangani Id., Mindanao (both USNM); Zamboanga, Mindanao (AMNH, DMNH); Siasi Id., Siasi Archipelago (MCZ, USNM). INDO-

NESIA: Malawili Chamel, North Borneo (Coll. M. Saul); Madura (RNHL); Samur, Bali (AMNH); Larantuka, Flores (RNHL); Ambon (AMNH, ANSP, MCZ, RNHL); Wahai, Ceram (BM); Hahnuhera; Kai Besar; Japen Id., Geelvink Baai, W. Irian (all RNHL); Kepulauan Auri, Geelvink Baai, W. Irian (ANSP). AUSTRALIA: QUEENSLAND: NE Herald Cay, Swains Reef (AMS); Sand Cay No. 8, Queensland (DMNH). PAPUA-NEW GUINEA: Admiralty Ids. (BM); Rabaul, New Britain (AMNH). SOLOMONS: Ataa Id., Malaita (AMNH); Shortland Id., Bougainville (ANSP). FIJI: Nadi Bay, Viti Levu (AMS); Lau Ids. (MCZ). SAMOAN ISLANDS: (BM), TONGA: Tongatapu (Colln. H. C. Gay). MARIANAS: Saipan (ANSP); Guam (USNM). PALAU ISLANDS: Kayangel (BPBM). CAROLINE ISLANDS: Losap Ids. (DMNH). MARSHALL ISLANDS: Boken Id., Taka, Rigili Id., Eniwetok; Lomuilal Id., Rongelap (all USNM). GILBERT ISLANDS: (MCZ).

Harpa tosa Aoki, 1966

(Pl. 210)

Range—Lower Pliocene (or Upper Miocene) of southern Shikoku, Japan (Nobori Formation).

Remarks—This species appears to be closest to *Harpa harpa* (Linné) but the upper portion of the body whorl is more rounded and not angulate. The ribs are also less spinose.

Description—The original description reads as follows:

Only one, rather well-preserved and almost complete specimen was collected. It is somewhat deformed transversely due to the diagenesis.

Shell moderate in size for the genus, vertically elongate, subovate, tumid and rather stout, height about 7 cm., maximum width about 4 cm. at the upper one third of the shell, consisting of about five whorls rapidly increasing in size; protoconch relatively small and compressed globose in shape; spire very low and bluntly pointed at the apex; body whorl very large, about 5/6 of the size of the shell; longitudinal ribs prominent, regularly arranged, thirteen in number at the body whorl, flat-topped and wide, running parallel to the growth lines; interspaces wider than ribs, posterior edges of ribs tending to pointed nodes at the shoulder, earlier five ribs of the body whorl covered with callus layer extending from the inner lip, becoming round-topped, weak and somewhat indistinct; growth lines fine but distinct on the ribs and interspaces; no spiral ornamentation present; aperture large and wide, subquadrangular in shape, more than 4/5 of the height [sic] of the shell, inner surface smooth, covered with a thick callus layer; outer lip rather thick; columella nearly straight, fold nothing; canal short and wide, somewhat recurved.

Holotype, Saitama Univ., Paleont. Coll., Reg. no. 11245; from a hill-side cliff, at Mimami-habuki,



Plate 210. *Harpa tosa* Aoki, 1966. Lower Pliocene of Japan. 70 mm. (from Aoki, 1966, pl. 31, figs. 12a, 12b).

Nishinohama, Hanemachi, Muroto City, Kochi Prefecture; Nobori formation, Upper Miocene or Lower Pliocene.

Synonymy—

1966 *Harpa tosa* Aoki, Trans. Proc. Palaeont. Soc. Japan, n.s., no. 62, p. 257, pl. 31, figs. 12 a, b.

***Harpa amouretta* Röding, 1798**

(Pls. 183, 189, figs. 6-11; Pl. 211)

Range—Red Sea and East Africa to Hawaii and Marquesas.

Remarks—This species is the most widely distributed of all species of *Harpa* and is found almost throughout the whole Indo-Pacific region. It is also the most variable in shape.

Harpa amouretta is distinguished from most other species by its smaller size, broadly to narrowly ovate shape, by the numerous fine chestnut lines on the ribs, and by the three widely separated blotches on the ventral surface, the central one, near the juncture of the columellar and parietal lips being the largest, the other two—at the upper end of the parietal lip and basal end of columellar lip being small and sometimes absent. It is most closely related to *Harpa gracilis* Broderip and Sowerby and to *Harpa harpa* Linné. From the former it differs in being larger, heavier, broader, and in possessing a pink or pale reddish rather than white protoconch; *H. harpa* is larger, broader, more inflated at the shoulder, with larger ventral blotches, and a peripheral row of irregular blotches on the body whorl.

The species exists in two principal forms; one is stout, strongly shouldered, rather heavy, often rather pale in color, and the other, more slender,

elongate, rather thin, and usually darker in color. The first form, often called *crassa* Mörch, is actually what Lamarck called *Harpa minor* (see below, under "Types"). It is the predominant form in the western Indian Ocean and is apparently the only form found in the Red Sea, but it is also found not infrequently in Micronesia and Melanesia. The other, more slender form is what Röding called *amouretta* and is common in the Pacific, but occasionally found also in the western Indian Ocean. I attempted to separate the two forms as distinct species with possibly distinct but overlapping geographical ranges, but found so much variation and intergradation without any real geographic differentiation in this complex, that I am uniting all under the earliest name, *Harpa amouretta* Röding.

Harpa solidula A. Adams, though not strongly shouldered, represents the stout, solid form; *H. virginialis* 'Gray' Sowerby seems to be a somewhat abnormal form of the "*crassa*" form with a peculiarly attenuated base.

Habitat—This species has been found living in both shallow and deep water. In Ceylon it was found crawling in sand on a reef in 3 inches of water (George Klime, in sched.). R. L. Sixberry, in his field notes, says that this species was found in Baie Taiohae, Nuku Hiva, Marquesas, at night and at low tide in reef flat tidal pools with maximum depths of 3 feet; it was found only on three consecutive nights so it may have been spawning when collected. On Vaitapu, Ellice Islands, Sixberry found it abundant on the reef flat at night in 0 to 6 inches of water. In the 1967 "Pele" expedition, we collected it in 5 to 15 feet of water under coral in Anse Hikapaa, Baie du Controleur, Nuku Hiva, Marquesas. In Hawaii the species apparently lives in deeper water than is usually the case elsewhere; here it has been found in 60 to 65 feet in sand under coral; it apparently spends most of its time buried in the sand with only the siphon visible (Adams, 1966, pp. 2, 5; Harrison, 1968, p. 1).

Description—Shell 20 to 60 mm. (3/4 to 2 3/8 inches) in length, varying from narrowly to broadly oval, moderately thin to solid and heavy, basally more or less effuse, body whorl large, spire conical, relatively large (25 to 37% of total length as compared to 21 to 23% for species such as *H. major* and *articularis*). Protoconch rather narrowly conical, consisting of 4 to 5 rounded, basally keeled, glassy whorls flesh pink to strong purplish red. First postnuclear whorl rounded, with numerous spiral cords crossed by strong axial, sub-



Plate 211. *Harpa amouretta* Röding. Holotype of *Harpa minor* Lamarck, 1822. Muséum d'Histoire Naturelle (Genève), 45.6 mm. in length.

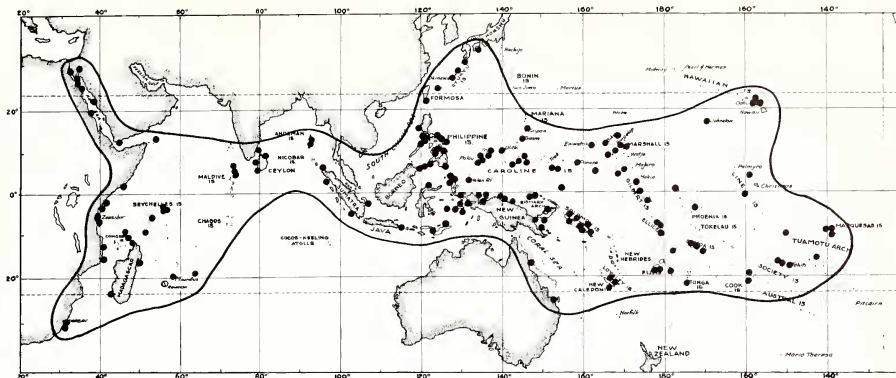


Plate 212. Geographical distribution of *Harpa amouretta* Röding.

lamellar ribs which are only weakly or not at all angulate at the shoulder; only the lower third or fourth of the whorl is covered by the arcuate flattened extension of the axial lamellate ribs of the succeeding whorl. Succeeding postnuclear whorls become more angulately shouldered with the spiral cords restricted to below the shoulder, and the axial ribs become increasingly more lamellar, and strongly angulate and subspinose at the shoulder; the callus formed by the anterior extension of the axial ribs of the succeeding whorl increasingly covers more of the whorl until it may cover more than half of the surface. The body whorl, below the subsutural angle or shoulder may be gently rounded ("amouretta form") or broader and subangulate below the shoulder ("crassa form"); the ribs, 11 to 15 in number (average 12.5) are triangular in cross-section, occasionally broadened towards the apertural lip, and the interspaces are faintly spirally striate and marked by fine axial growth striae. Ground color of shell very pale yellowish white to deep straw yellow, strongly marked in the intercostal spaces with chestnut brown in varying shades (shells from certain areas, such as the Marquesas have a very dark overall coloration) and in varying patterns, generally of a festooned, zigzag pattern, with irregular splotches, all usually in a basically banded arrangement; in the earliest postnuclear whorls the coloration is restricted to subsutural spots of chestnut which in later whorls tend to become large blotches. The ribs are marked by numerous fine spiral lines in pairs, these pairs usually grouped together and often with darker ground color between them and giving an overall

banded pattern to the whorl. Aperture narrowly ovate, posteriorly more or less acuminate, anteriorly (or basally) rather effuse; outer lip heavy (in the *crassa* form) or rather thin (in the *amouretta* form), not thickened within; inner lip gently arcuate or almost straight, parietal wall covered with a thin glaze which is heavier over the columellar area, extending over the upper part of the strong siphonal fasciole. The inner lip is usually marked by two or three chestnut blotches, one at the juncture of the parietal and columellar lips, one near the juncture with the outer lip, and the other at the base of the columellar lip near the anterior canal; the latter is the smallest and is almost always present, the middle one is usually present but varies greatly in size and shape, and the uppermost one is often absent, especially in the "amouretta" form.

The animal is occasionally darker in coloration than in *major* and *ventricosa* and a specimen from the Marquesas shows strong crowded vertical grooves on the anterior margin of the propodium.

Measurements (mm.)—

| length | width | no. whorls | |
|--------|-------|------------|-----------------------------------|
| 59.7 | 31.8 | 7½ | large; Lubang, Philippines |
| 52.2 | 28.8 | 7½ | large; Samar, Philippines |
| 48.6 | 28.9 | 7 | large; Zanzibar |
| 38.8 | 22.4 | 7 | medium; Kapingamarangi, Carolines |
| 37.1 | 24.7 | 6½ | medium; Mauritius |
| 33.6 | 20.6 | 6½ | medium; Satawan, Carolines |
| 29.8 | 16.7 | 7 | small; Sumatra, Indonesia |
| 22.7 | 13.0 | 6½ | small; Seychelles |
| 20.3 | 10.7 | 5½ | small; Jaluit, Marshalls |

Synonymy—

- 1798 *Harpa amouretta* Röding, Museum Boltenianum, p. 150; refers to Martini, Conchylien-Cab., vol. 3, p. 421, pl. 119 fig. 1097 (Amboina); 1938, Adams and Leloup, Res. Sci. Voyage Indes Orient. Néerl., vol. 2, fasc. 19,

- p. 193; 1939, Peile, Proc. Malac. Soc. London, vol. 23, pp. 271-272, fig. 40 (radula); 1948, M. Smith, Triton, Helmet and Harp Shells, p. 46, pl. 16, fig. 1; 1958, Tinker, Pacific Sea Shells, ed. 2, p. 162, fig.; 1962, Kira, Shells of the Western Pacific in Color, p. 90, pl. 32, fig. 16.
- 1807 *Harpalis amouretta* Link, Besch. Nat.—Sammlung Univ. Rostock, pt. 3, p. 114.
- 1817 *Harpa oblonga* Schumacher, Essai Nouv. Syst. Hab. Vers Test., p. 208; refers to Martini, Conch.-Cab., vol. 3, fig. 1097.
- 1822 *Harpa minor* Lamarck, Hist. Nat. An. s. Vert., vol. 7, (Indian Ocean), p. 257; 1833, Quoy and Gaimard, Voyage Astrolabe, Zoologie, vol. 2, p. 620, pl. 42, figs. 5-7 (animal); 1835, Kiener, Spec. Gen. Icon. Coq. Viv., vol. 8, Gen. Harpe, p. 10, pl. 6, fig. 6a; 1843, Reeve, Conch. Icon., vol. 1, *Harpa*, pl. 3, figs. 6a, 6b; 1853, Chenu, Illust. Conch., vol. 4, (pt. 85) pl. 2, figs. 5-7; 1857, Kuster, Neues Syst. Conch.—Cab., ed. 2, vol. 3, pt. 1B, pp. 91-92, pl. 67, figs. 6, 7; 1877, Sutor, Jahrb. deutsch. Malak. Ges., vol. 4, pp. 115-117; 1883, Tryon, Man. Conch., vol. 5, p. 99, pl. 41, fig. 69-72, 78.
- 1848 *Harpa crassa* "Philippi" Krauss, Südafrikanische Moll., p. 119 (South Africa); 1852, Mörch, Cat. Conch. Yoldi, fasc. 1, p. 125; refers to Martini, Conch.—Cab., vol. 3, pl. 119, fig. 1095; 1860, Sowerby, Thes. Conch., vol. 3, p. 171, pl. 233, figs. 30-31; 1877, Sutor, Jahrb. deutsch. Malak. Ges., vol. 4, pp. 117-119.
- 1854 *Harpa solidula* A. Adams, Proc. Zool. Soc. London, pt. 21, p. 173, pl. 20, figs. 9-10.
- 1857 *Harpa gracilis* Brod. and Shy., Küster, Neues Syst. Conch.—Cab., ed. 2, vol. 3, pt. 1B, p. 91 (in part), pl. 67, figs. 4, 5. Not *gracilis* Brod. and Shy., 1829.
- 1870 *Harpa virginialis* "Gray" Sowerby, Thes. Conch., vol. 3, p. 172, pl. 233, figs. 34, 35; 1883, Tryon, Man. Conch., vol. 5, p. 99, pl. 71, fig. 78 (as syn. of *minor* Lam.).
- 1860 *Harpa solida* A. Ad., Sowerby, Thes. Conch., vol. 3, p. 172, (as syn. of *crassa* Mörch; error for *solidula* A. Ad.).

Types—*H. amouretta* Röding was based on a specimen described and figured by Martini from his collection; the present location of this specimen is not known. The type locality is Ambon, Indonesia.

The holotype of *Harpa minor* Lamarck is in the Natural History Museum of Geneva (Plate 211), and represents the heavy shouldered form; it measures 45.6 mm. in length. Of the four specimens of this species in the Lamarck Collection in Geneva, three are of the *crassa* form, and one of the *amouretta* form.

The type of *Harpa crassa* "Philippi" Krauss is not present among what remains of Krauss' collection in the Museum of Natural History in Stuttgart (see Janus, 1961). Three syntypes of *Harpa crassa* Mörch, 1852, which Mörch listed as a new taxon, are present, on the other hand, in the Zoological Museum in Copenhagen; the largest specimen, which is in wear, measures 35.5 mm. in length, the other two 33.5 and 33 mm. I designate the one measuring 33.5 mm. as the lectotype. Since the original label bears the locality data "Isle de Fr.," the type locality should be Mauritius.

Harpa solidula A. Adams is represented in the British Museum Collection by three syntypes originally glued on a tablet and belonging to the Cuming Collection. Of these the smallest and most vividly colored one agrees quite closely with the original figure, and so I designate it as the lectotype; it measures 33.5 mm. in length and 20 mm. in width.

The whereabouts of the type of *Harpa virginialis* "Gray" Sowerby is not known.

Selected Records (for additional records see map)—SOUTH AFRICA: off Durban, Natal, from fish stomach (DMNH); Umntwalmi, 22 mi. N of Port Shepstone, Natal (ANSP). MOZAMBIQUE: Porto Amelia (AMNH, USNM); Moçambique (USNM). TANZANIA: Latham Id., 50 mi. E of Dar es Salaam (Colln. Vokes); 4 mi. N of Dar es Salaam (MCZ); Bawe Id., 4 mi. NW of Zanzibar City (USNM); Ras Kizimkazi, SW Zanzibar (ANSP). KENYA: 16 mi. S of Mombasa (ANSP); Tiwi (MHNG); 4 mi. SE of Gedi, Kilifi Distr. (AMNH). SOMALIA: Mogadiscio (AMNH, ANSP, USNM). SOCOMTRA: North Coast (ANSP), RED SEA: Gulf of Suez (BM, MCZ); Eilat, Gulf of Aqaba (AMNH, BM, TAU); Ras Muhammed, S tip Sinai (TAU); Dishet ad Dab'ah, Egypt (RNHL); E of Jabal Zabarrah, Egypt (ANSP); 40 km N of Jidda, Saudi Arabia (AMNH); Jidda (RNHL); Port Sudan, Sudan (AMNH, MCZ). ADEN: (BM). MADAGASCAR: Nosy Bé (ANSP, MCZ, RNHL); NW of Ambodifototra, Ile Ste. Marie; Grande Réfécite, Tulear (both MCZ); SEYCHELLES: Anse Boileau, W Mahé (ANSP, BM); 1 mi. S of Anse aux Pins, SE Mahé; Curieuse Id. (both ANSP); La Digue (BM). MAURITIUS: Flie-en-Flacq; nr. Black River (both ANSP). LA REUNION: (Deshayes, 1863). INDIAN OCEAN ISLANDS: Darros Id., Amirante Isles (BM); St. Josephs Ids., Amirantes (Colln. Vokes); Iles Glorieuses; Providence Id. (both USNM); West Id., Aldabra (Colln. Vokes); Rodrigues (BM). MALDIVES: Fadiffolu Atoll; Tildamunati Atoll; N. Malosmadulu Atoll (all ANSP); CEYLON: Calle Beach (AMNH, BM); Fort Frederick, Trincomalee; Hikkadhwa (both ANSP). INDIA: Tranquebar (ZMC). ANDAMAN ISLANDS: Bonnington; Long Id.; Port Blair (all BM); JAPAN: S coast Shikoku and southwards (Kira, 1962); Osumi Gunto, Ryukyu Ids. (MCZ, USNM); Naha, Okinawa, Ryukyu Ids. (ANSP); Taketomi Shima, Ryukyu Ids. (BPBM). TAIWAN: (USNM); Oluan Pi (ANSP). PHILIPPINES: Batangas Bay, Batangas, Luzon (AMNH); Botolan, Zambales, Luzon (ANSP); Gignoto, Catanduanes (ANSP, DMNH); Tiliac Bay, Lubang (ANSP); Pola, Mindoro (AMNH); Calapan, Mindoro (MCZ); Culion (AMNH); Capul, NW Samar (ANSP); Borongan, E Samar (ANSP, DMNH, MCZ, USNM); Cebu City, Cebu (ANSP, DMNH); Panglo Id., Bohol (AMNH); Davao, Mindanao (MCZ, USNM); Zamboanga, Mindanao (ANSP, DMNH, USNM); Pt. Matangal, Basilan; Jolo City, Jolo (both USNM); Siasi, Sulu Archipelago (AMNH, DMNH); SW end Sanga Sanga Id. (ANSP). INDONESIA: Pulau We, N Sumatra (RNHL); Pulau Penjoe, Pulau Simeulue, W Sumatra (USNM); Pulau Bali, W Sumatra; Bengkulu, S Sumatra; Bangka (all RNHL); Bali (BPBM, MCZ); Timor; Wetai; Bandanaira, Banda; Lintido, Celebes (all RNHL); Busak, N Celebes; Karakelong, Kepulauan Talud; Pulau Daguasuli, Loloda Utara, Halmahera (all MCZ); Pulau Tenga, Buru; Manjua, W Ceram (both RNHL); Pulau Boama, Ceram (ANSP); Ambon (ANSP, MCZ, RNHL); Wahai Ceram (BM). INDONESIA: WEST IRIAN: Pulau Gami (MCZ); Ceramak; Manokwari (both MCZ); Pulau Maransabadi, Kepulauan Auri; Soepiori, Kepulauan Schouten; Niaki, Kepulauan Schouten (all Geelvink Baai, and ANSP); Pulau Nukor, Kepulauan Padoido, Geelvink Baai (MCZ); Insunamai, Kepulauan Wakde (MCZ); nr. Ifflandia (USNM). PAPUA-NEW GUINEA: Seleni Id., Aitape; Finschhafen (both MCZ); Oro Bay (ANSP). QUEENSLAND: Tin Can Bay (MCZ); Green Id.

(AMNH). ADMIRALTY ISLANDS: Manus Id. (MCZ); Koromati Id. (ANSP); Los Negros Id., (USNM). NEW BRITAIN: Kumbun Id., nr. Kandrian (ANSP); Rabaul (AMNH, ANSP); Blanche Bay (RNHL). SOLOMON ISLANDS: Kieta, Bougainville (AMNH); Shortland Id. (ANSP); Treasury Ids. (USNM); Choiseul Bay, Choiseul (AMNH); Roviana, New Georgia (MCZ); Pavuvu Id., Russell Ids. (USNM); Ataa, N Malaita (AMNH); Ugi (USNM). NEW CALEDONIA: 2 mi. SSE of Touho (ANSP); Noumea (MCZ). LOYALTY ISLANDS: Lifu (USNM). FIJI: Korolevu, Viti Levu (ANSP); Mbengga, S of Viti Levu (USNM); Lau Ids. (MCZ). HOORN ISLANDS: Anse de Sigave, Futuna (USNM). SAMOAN ISLANDS: Asau Harbour, Savaii; Apia, Upolu; nr. Matanitu Pt. Apia, Upolu (all USNM); Tutuila (ANSP). TONGA: Tongatapu (MCZ, USNM). MARIANA ISLANDS: Agrihan; Saipan; Port Merizo, Guam (both ANSP); Agaña Bay, Guam (ANSP, BPBM); Cocos Id., S of Guam (ANSP). PALAU ISLANDS: E Babelthuap (ANSP, MCZ, USNM); reef off Airai, Babelthuap; Malakal Harbor; N side Ngarapala, Kayangel Islets (all ANSP). CAROLINE ISLANDS: Round Rock, Helen Reef (ANSP); Ngulu Atoll (USNM); Yap (ANSP, USNM); Ulithi Atoll; Fassara; Ids., Ulithi Atoll; Enriipik Atoll; Falarik Id., Ialik Atoll; Faraulip Atoll; Elato Atoll (all USNM); Lamotrek Atoll (BPBM, USNM); Satawal Id.; W side Oneop Id., Lukunor Atoll; Satawan atoll; Kapingamarangi Atoll; Toihou Id., Kapingamarangi Atoll (all USNM); Losap Ids. (DMNH); Ponape (ANSP, BPBM, MCZ); Mutunlik, Kusaie (ANSP, BPBM). MARIAN ISLANDS: Rujori Id., Eniwetok; Aranui Is., Eniwetok; Namu Id., Bikini; Yonyanar Id., Bikini; Bock Id., Rongerik; Lato-back Id., Rongerik; Wotho; Bigenka Id., Ujae; Torrutji Id., Kwajalein; Mejatto Id., Jaluit (all USNM); Ebon (MCZ, USNM); Bikar; Boken Id., Taka; (both USNM); Likiep (BPBM); Mejbin Id., Majuro (USNM); Arno (AMNH). GILBERT ISLANDS: Abaiang (MCZ); Abemama; Onotoa (both USNM). ELLICE ISLANDS: Vaitupu (USNM); Funafuti (MCZ); Nukulaeae (USNM). HOWLAND ISLAND: ANSP, MCZ). PHOENIX ISLANDS: Canton (BPBM). EASTERN POLYNESIA: (ANSP). LINE ISLANDS: Fanning; Jarvis (both DMNH); Caroline atoll (ANSP, USNM). COOK ISLANDS: betw. Black Rock and Nikao, NW Rarotonga (ANSP, MCZ); Avatiu Harbor, Rarotonga; Manuae, Hervey Ids. (both USNM). SOCIETY ISLANDS: Paitupu, Papeete, Tahiti (USNM); Vairahi Bay, Raiatea; (ANSP); Tahaa (DMNH); Bora Bora (both ANSP). TUAMOTUS: Takume (USNM). MARQUESAS ISLANDS: Baie Taiohae, Nuku Hiiva (DMNH, USNM); Anse Hakapaa, Baie du Contrôleur, Nuku Hiiva (USNM); Baie Hanahaveana, Ta-

huata; Baie d' Hanania, Ua Huka (both ANSP). HAWAIIAN ISLANDS: Waikiki, Oahu (T. Richert Colln); Waiananalo Bay, Oahu (MCZ); Honolulu Harbor (USNM); Kaunapali, Maui (Colln. R. Gage). JOHNSTON ISLAND: Sand Island (USNM).

Fossil records—INDONESIA: near Kajoe Raji, N Celebes; age: Pleistocene (Schepman, 1907, p. 164). MARIANAS: 1650 ft., E by S of Mt. Almagosa, Guam, in Talsay member of Alifan limestone (USGS 20640); age: Upper Miocene (Tertiary *g*) or Pliocene (Tertiary *h*). HAWAIIAN ISLANDS: 40-50 ft. alt., lava cliff, Kapihaa Bay, Lanai; age: Pleistocene (Y. Kondo, BPBM); 250-290 ft. alt., Kawaiu Stream, Lanai (USGS 13918); age: Pleistocene (H. T. Stearns, USNM). PHOENIX ISLANDS: emergent reef (2600 years old), Enderbury Island (J. I. Tracy, Jr., USNM).

Harpa gracilis Broderip and Sowerby, 1829

(Pl. 189, figs. 3-5)

Range—Ellice Islands to the Tuamotus, and Clipperton Island.

Remarks—This small and distinctively characterized species is still rare in collections. From small elongate specimen of *H. amouretta* it can be differentiated by possessing a narrow umbilicus, a more slender shape, higher spire, white protoconch, more slender ribs not angulate at the shoulder, and an anteriorly more effuse aperture.

Sutor (1877) records *gracilis* from Rarotonga in the Cook Islands and the Gilbert Islands. The former locality needs verification, and from Abemama in the Gilbert Islands and Vaitupu in the Ellice Group I have seen narrow, rather thin specimens that have a resemblance to *gracilis* but are definitely *Harpa amouretta*. Hedley (1899) records the species from Funafuti, Ellice Islands, and I have seen two specimens from this atoll.

During a visit to Clipperton Island in 1959 of the Scripps Oceanographical Institute research vessel "Downwind," a specimen was collected by E. A. Allison on the beach. I have been able to examine the two specimens collected on Clipperton during the French "Bougainville" Expeditions, 1966-1968 (Salvat and Ehrhardt, 1970, p. 226).

This wide but scattered distribution is interesting, but further intensive collecting in the Northern Cook Islands and the Line Islands may reveal its presence there. It is difficult to explain its occurrence in Clipperton, as we know nothing of the early stages of development in the genus.

A specimen in the Delaware Museum of Natural History is said to have come from a coral reef at low tide off Papeete, Tahiti. Its presence on a high island (all other known specimens are from coral atolls) is suspect, and as the collector is unknown, I am treating this record as doubtful.

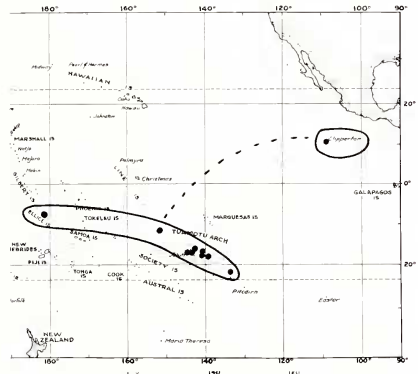


Plate 213. Geographical distribution of *Harpa gracilis* Broderip and Sowerby.

Description—Adult shell 25 to 29 mm. (1 to 1 1/8 inches) in length, narrow-elongate, basally somewhat effuse, with a moderately high conical spire. Nuclear whorls 3 1/2 to 4, smooth, white, early postnuclear whorls white or pale rosy-white, marked by evenly spaced low retractively curved axial ribs, the interspaces marked by fine spiral lirae that run up onto the apertural edge of the ribs; ribs on penultimate whorl marked by transverse lines of chestnut brown, becoming obscure where they are covered by the parietal callus glaze. On body whorl the ribs are low, flattened, of varying width, marked by chestnut-brown lines usually arranged in groups of three or four; the ribs on the ventral side appear to vanish under the thin parietal glaze which at the lower end partially covers the siphonal fasciole and the narrow umbilicus. Aperture elongate, narrow at the posterior end, broad at the anterior end.

Measurements (mm.)—

| length | width | no. whorls | |
|--------|-------|------------|-------------------------------|
| 35.4 | 16.5 | — | large; Tuamotus |
| 29.2 | 14.5 | 6 | large; Anaa, Tuamotus |
| 27.6 | 13.1 | 6 | average; Vahitahi, Tuamotus |
| 26.4 | 12.9 | 4½ | average; Flint Id., Line Ids. |
| 20.5 | 10.2 | 5 | small; Raroia, Tuamotus |
| 24.4 | 11.3 | 6½ | small; Funafuti, Ellice Ids. |

Synonymy—

- 1829 *Harpa gracilis* Broderip and Sowerby, Zool. Journal, vol. 4, p. 373 (no locality; type locality here designated as Vahitahi, Tuamotus); 1843, Reeve Conch. Icon., vol. 1, Harpa, pl. 2, fig. 3a, b (Anaa Id.); 1860, Sowerby, Thes. Conch., vol. 3, p. 171, pl. 233, figs. 32, 33; 1877, Sutor, Jahrb. deutsch. Malak. Ges., vol. 4, pp. 120-121; 1883, Tryon, Man. Conch., vol. 5, p. 99, pl. 41, fig. 73; 1899, Hedley, Mem. Austral. Mus., vol. 3, p. 470; 1907, Coutourier, Journ. de Conchyl., vol. 55, p. 132; 1933, Dautzenberg and Bouge, Journ. de Conchyl., vol. 77, p. 149-150.
- 1839 *Harpa minor* *B. gracilis* Brod. and Sby., Gray, Zool. Capt. Beechey's Voyage, p. 122, pl. 36, fig. 17 (Pacific Ocean).
- 1948 *Harpa amouretta gracilis* Brod. and Sby., M. Smith, Triton Helmet and Harp Shells, p. 46.

Types—According to the original authors the species was described from a single specimen collected by Lt. Belcher while on the voyage of the "Blossom" under Captain Beechey, and at that time in "Mr. Bland's collection." The whereabouts of this collection and the type of this species are unknown; it may be the same collection as that listed by Sherborn (1940, p. 19) as "Mich. Bland," a collection he states was sold at auction in May 1851. According to Rosewater (1968, p. 351) the "Blossom" visited thirteen atolls in the Tuamotus. Of these I designate Vahitahi as the type locality. Anaa, the atoll where Cuming collected the specimen figured by Reeve, was not visited by the "Blossom."

Records—ELLICE ISLANDS: Funafuti (AMS). SOUTHERN LINE ISLANDS: Flint Id. (ANSP). TUAMOTUS: Anaa (AMNH, ANSP, BM); Raroia; Vahitahi (both USNM); North Marutea; Anaa; Hao, South Marutea (all Seurat, in Dautz and Bouge, 1933). CLIPPERTON: (CAS, MHNP).

***Harpa kajiyamai* new species, Rehder**

(Pl. 188, figs. 3, 4)

Range—The southern Philippines.

Remarks—It is remarkable that this rather striking species has been unrecognized as distinct for so long. In 1966 Habe and Kosuge (Shells of the World in Colour, vol. II: The Tropical Pacific, p. 79, pl. 30, fig. 3) described this shell as *Harpa cancellata* Röding, 1798. They call attention to its rather narrow form, and the thinness of the glaze on the parietal wall. It is of course not *H. cancellata* Röding, which I consider a synonym of *H. davidis* Röding. Dr. Habe in a letter to me said he had recognized that the species in question was new, and had given it a provisional new name. Upon my request Dr. Habe very generously sent me three specimens of this species that had been loaned to the National Science Museum in Tokyo, and is permitting me to describe this species. At his request I am naming it for Mr. Hikotaro Kajiyama who brought these specimens to Dr. Habe.

The most obvious characters that differentiate it from related species is the rather elongately ovate shape and the presence of only a thin glaze on the parietal wall with two chestnut brown spots on the ventral side—a larger, elongate one at the base of the parietal wall above the upper end of the siphonal fasciole, and a small one near the base of the columellar; occasionally there may be small spot on the parietal wall near the junction of the outer lip.

Its closest relative in some aspects is *Harpa amouretta* in the thinness of the glaze on the parietal wall, the spot at the base of the parietal wall, and in the presence of numerous transverse dark lines on the ribs. It is, however, more ovate, with a lower spire, and a larger spot at the base of the columellar wall. In this respect it is more like *H. major*. It is larger than *H. amouretta*.

Description—Of moderate size, adult shells 67.7 to 72.4 mm. (2½ to 2¾ inches) in length, ovate, with body whorl convex but medially slightly flattened, spire moderately high, conical. Protoconch erect-manillate, pale yellowish pink to light pink, with 3¼ to 3½ smooth, convex whorls, with medial keel rather prominent; usually somewhat tilted. Early postnuclear whorls with distant axial ribs and a rather strong spiral ridge at the shoulder and one or more visible below the shoulder; the area

of the whorls covered by the procurved upper ends of the ribs of the succeeding whorl increases rapidly so that in the latter half of the second post-nuclear whorl, the callus covers all of the whorl below the subsutural shoulder, and in the last two whorls even the shoulder is covered; the axial ribs (17 to 19 in penultimate whorl) bear a strong triangular spine at the shoulder angle; the subsutural ramp is smooth. Body whorl ovate, slightly flattened medially, with 14 to 17 ribs which are sharply acuminate at the shoulder angle, smooth below, and flattened and reflected, strongly reflected at base towards the strong siphonal fasciole where the ends of the ribs are conspicuous and flattened; the subsutural ramp is very finely axially sculptured by microscopic irregular growth lines which become obsolete below the shoulder between the ribs where they are replaced by stronger, separated axial threads, crossed by numerous fine, low spiral ridges of irregular strength, with occasionally more pronounced ones among them. The parietal wall is covered by a thin transparent glaze, which becomes thicker towards the siphonal fasciole and over the columellar area, covering the inner part of the fasciole. A large, elongately curved, dark reddish brown to grayish reddish brown spot is situated at the base of the parietal wall just above the upper part of the light yellowish brown siphonal fasciole; a small spot of the same color is situated on the columella above the anterior tip which is grayish yellow; occasionally this dark spot extends up on the columellar to below the siphonal fasciole. Occasionally a small or obscure spot is present on the parietal wall near the juncture with the outer lip. Outer lip evenly arcuate, not much thickened, marked by the ends of the spiral banded coloration of the exterior. The color of the exterior of the shell is vivid and of the typical *Harpa* pattern, the darker spots on the ribs being marked by seven groups of horizontal dark lines, usually in pairs or triplets. Occasionally a spiral series of irregular splotches of moderate reddish brown is present in the middle section of the body whorl. The anterior siphonal sinus is broad and open.

Measurements (mm.)—

| length | width | no. whorls | |
|--------|-------|------------|----------------|
| 72.4 | 48.5 | 7 | Holotype |
| 69.8 | 46.2 | 7 | Paratype no. 1 |
| 67.7 | 41.4 | 7½ | Paratype no. 2 |

Synonymy—

1966 *Harpa cancellata* Röding, Habe and Kosuge, Shells of the World in Colour, vol. 2: The Tropical Pacific, p. 79, pl. 30, fig. 3. Not *Harpa cancellata* Röding, 1798.

Types and Records—The holotype is in the National Science Museum of Tokyo, no. 41450, while paratype no. 1 is in the collection of Mr. Hikotaro Kajiyama, and paratype no. 2 is in the collection of Mr. Ryosuke Kawamura.

Harpa major Röding, 1798

(Pl. 183; Pl. 188, figs. 8-11; Pl. 214)

Range—East Africa to Hawaiian and Marquesas Islands.

Remarks—This is a very widely-spread species and also rather variable in its color pattern and in the nature of the ribs. It is in general characterized by its rather heavy, oval and not angulate shell, the chestnut blotch on the ventral surface more or less divided in the center of the parietal wall with the lower part continuing down without interruption to the base of the columellar. Specimens of this species vary from those with a generally pale pink coloration, wide ribs and without any dark lines on the ribs to dark forms with numerous dark lines on the ribs.

The species that Sutor (1877, p. 107) described as *Harpa ligata* Menke appears to represent this latter darker form (Sutor calls the coloration "intense") with numerous dark lines on the ribs, a broadly ovate shape with short spire and a generally dark parietal blotch with only a small elongate light area in the middle. The general outline of the shell, height of spire, number of dark lines on the ribs, and the extent of the dark chestnut ventral blotch varies so much in various combinations throughout the range, that no distinct specific or subspecific separation can be made based on these characters. There seems to be a center of

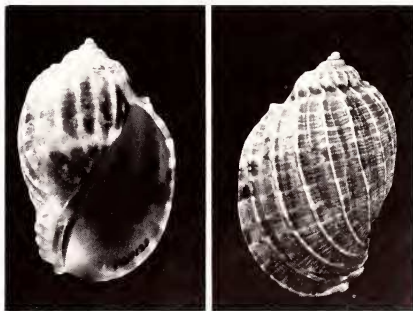


Plate 214. *Harpa major* Röding. Lectotype of *Harpa striatula* A. Adams, 1854, 44 mm. in length. British Museum (Natural History). No. BM 1965-133.

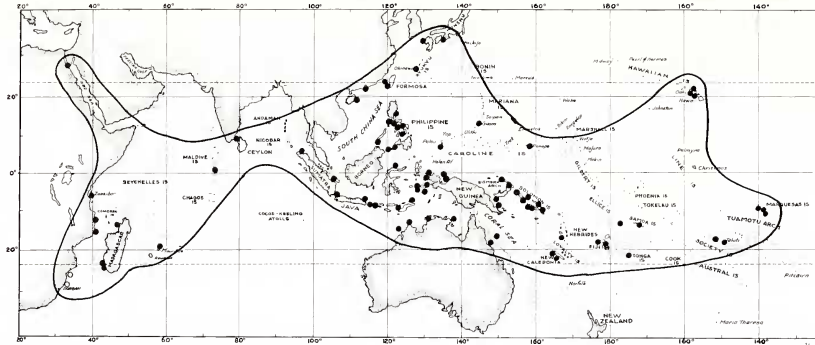


Plate 215. Geographical distribution of *Harpa major* Röding.

deep-colored forms with a more or less solid dark-chestnut blotch on the ventral surface in central Melanesia; I have seen such specimens from the Sulu Archipelago in the Southern Philippines, New Britain, Solomons, and eastern Papua, but as more typical forms are also found in the same area, I consider these dark forms to be merely ecological variations.

I have seen a specimen from Oahu, Hawaii with a pale pink and white ground color on both ribs and interspaces, with strong paired dark lines on the ribs.

Occasional small specimens are found in which the striate sculpture of the intercostal areas, typically found in the juvenile stage, is continued and even conspicuously strengthened in later whorls. On two such specimens, 44 mm. and 50 mm. in length, A. Adams founded his *Harpa striatula* (Plate 214). Oostingh (1938, pl. 7, fig. 144) figures such a shell from the Pliocene of Java.

Habitat—A deeper water shell living on a bottom of sand or rubble. C. S. Weaver mentions (1963, p. 1) having taken a living specimen moving over the sand in 55 to 60 feet of water in Kailua Bay, Oahu, Hawaii. In the Marquesas numerous living specimens were dredged in from 26 to 51 fathoms on bottoms of varying proportions of sand, broken shell and rubble.

Description—Shell 50 to 108 mm. (2 to 4¼ inches) in length, broadly oval, usually solid and comparatively heavy, last whorl large, spire broadly conical. Protoconch conical, of 3¾ to 4 whorls, rounded, glassy, flesh-colored. Early post-nuclear whorls showing sharp axial ribs and two or three spiral cords, giving those whorls on the spire a cancellate appearance, and the uppermost

one giving these whorls a shouldered appearance with a flattened subsutural area; the color changes from the flesh color of the nuclear whorls to white, often with scattered chestnut spots. In the juvenile shells the interspaces are sculptured with low, broad, and flattened spiral cords, subequidistantly spaced, and crossed by very fine, crowded and sharp axial threads. The last two whorls of the spire are covered with a glaze varying in color from flesh or cocoa color to yellowish and dark coffee color. Body whorl comprises about 90 to 95% of the total shell length, and bears 12 to 16 ribs of varying widths; the ribs are prominently and subspinosely angulate at the edge of the subsutural ramp, the spines on the last whorls giving a channeled appearance to the spire; at the suture the ribs flatten out and coalesce forming a callus that covers the penultimate whorl; between the ribs the surface is axially finely striated. The color of the shell varies from pinkish flesh-color to deep reddish brown with the area between the ribs showing an axially festooned pattern of pink, white or chestnut. There is always some sort of a banded pattern shown that is carried out on the ribs also; the presence or absence of chestnut lines on the ribs is a variable character. The aperture is rather large, ovate, the outer lip simple, gently arcuate with a shallow anal sinus between the spinose angulation and the suture. The lower part of the lip curves away retractorily to the rather broad siphonal canal. The columellar lip is bounded by a strong rounded fasciole, lamellosely ridged by the strongly and retractorily curved basal ends of the ribs. The whole parietal wall and columellar area is covered with a glaze, which bears a large deep chestnut blotch extending from the suture to almost the end of the columellar lip; in the middle of the parietal wall a narrow or

wedge-shaped light area nearly or completely divides the blotch into two parts. The ribs on the parietal wall are only lightly colored and show through prominently. The basal tip and inner part of the columellar lip is straw-colored or pale brown. The interior of the aperture is largely colored a light brown; near the outer lip it is paler with the color banding often showing through.

Measurements (mm).—

| length | width | no. whorls | |
|--------|-------|------------|-------------------------------|
| 105.3 | 69.0 | 7 | large; Guam, Marianas |
| 93.6 | 64.6 | 6½ | large; Cebu City, Philippines |
| 82.5 | 59.4 | 6½ | average; Ryukyu Islands |
| 69.8 | 47.2 | 6½ | average; Okinawa, Ryukyus |
| 51.1 | 32.9 | 6 | small; Okinawa, Ryukyus |
| 48.4 | 33.7 | 6 | small; Lubang, Philippines |

Nomenclature—This species is one of the most variable in the genus and consequently a great deal of confusion has arisen concerning its proper name. Recent workers (Wagner and Abbott, 1967, pp. 115-116) have equated *major* Röding with *ventricosa* Lamarck and *conoidalis* Lamarck with *dauidis* Röding, a confusion that dates back to Lamarck who placed references now assigned to *major* under his *ventricosa*. Other workers (Maxwell Smith, 1948, p. 47; Habe, 1961, p. 68) have synonymized *Harpa major* with *dauidis* Röding. It is worthy of comment that although the species on which Röding based his *Harpa major* is what Martini in 1777 called "Die grosse Davidsharfe" Röding gave the name *Harpa dauidis* to another shell described and figured by Martini in the same volume.

Synonymy—

- 1798 *Harpa major* Röding, Museum Boltenianum, Hamburg, pt. 2, p. 149, no. 1872; refers to Conchyl.-Cab., vol. 3, pl. 119, f. 1090 (East Indies); [The figures of Knorr cited by Röding represent *Harpa harpa* L.]
- 1807 *Harpatis major* Link, Besch. Nat. Samml. Univ. Rostock, pt. 3, p. 114; refers only to Conchyl.-Cab., vol. 3, pl. 119, f. 1090.
- 1811 *Harpa grandiformis* Perry, Conchology, pl. 40, no. 1 (West Indies)
- 1817 *Harpa vulgaris* Schumacher, Essai Nouv. Syst. Hab. Vers Test; p. 208. New name for *Harpa ventricosa* Lamarck in part.
- 1818 *Buccinum harpa* Wood, Cat. Shells, p. 107, pl. 22, f. 49. Not *B. harpa* Linné, 1758.
- 1822 *Harpa conoidalis* Lamarck, Hist. Nat. An. s. Vert., vol. 7, p. 255 (no locality); 1843, Reeve, Conch. Icon., vol. 1, Harpa, pl. 3, f. 7a, 7b, 7c; 1962, Kira, Shells Western Pacific in Color, p. 90, pl. 32, f. 17.
- 1822 *Harpa ventricosa* Lamarck, op. cit., p. 255 (East Indies), in part; 1833, Quoy and Gaimard, Voy. Astrolabe, Zool., vol. 2, p. 611-619, pl. 42, f. 1-4 anatomy (not *H. ventricosa* Lam.); 1843, Reeve, Conch. Icon., vol. 1, Harpa, pl. 1, sp. 2 (in part; fig. 2a only)
- 1828 *Harpa ligata* Menke, Syn. Meth. Moll., p. 86 (no locality); 1877, Sutor, Jahrb. deutsch. Malak. Ges., vol. 4, p. 107, pl. 5, f. 2 (Duke of York Ids. [Tokelau Ids.])

- 1835 *Harpa ventricosa* var. *conoidalis* Lam., Kiener, Spéc. Gén. Icon. Coq. Viv., Gen. Harpe, p. 7, pl. 3, f. 4.
- 1835 *Harpa ventricosa* Lam., var., Kiener, op. cit. p. 7, pl. 6, f. 9-10.
- 1835 *Harpa nobilis* Lam., var., Kiener, op. cit., p. 10, pl. 6, f. 11.
- 1854 *Harpa striatula* A. Adams, Proc. Zool. Soc. London, pt. 21 (1853), p. 173, pl. 20, f. 7, 8 (no locality); juvenile.
- 1860 *Harpa nablum* 'Mart.' Sowerby, Thes. Conch., vol. 3, p. 170 (in part), pl. 232, f. 14, 17. Not *H. nablum* Mörch, 1853.
- 1961 *Harpa dauidis* Rödl., Habe, Col. Illustr. Shells, Japan, vol. 2, p. 68, pl. 33, f. 24. Not *H. dauidis* Röding, 798.

Types—The whereabouts of Martini's specimen on which Röding's name is based is unknown. Pending the possibility of the eventual discovery of Martini's specimen, his illustration may serve as a "type figure." The type locality, given as East Indies, I restrict to Ambon.

The type of *Harpa conoidalis* Lamarck could not be found in the museum in Geneva, and may be in existence in France. The types of Menke's *ligata*, and Perry's *grandiformis*, have also not been located.

Two cotypes of *Harpa striatula* A. Adams were found in the British Museum; the smaller one, measuring 44 mm. in length and 29 mm. in width, is the one figured by Adams, and is designated as the lectotype (BM 1965-133).

Records (see accompanying map, pl. 215)—SOUTH AFRICA: off Unvoti River (Barnard, 1959, p. 35). MOZAMBIQUE: Baía de Lourenço Marques (Barnard, l. c.); Moçambique (ANSP, DMNH); Porto Amelia (USNM). TANZANIA: Zanzibar (AMNH, ANSP); Chambe Id., SW Zanzibar; Pange Id., W Zanzibar; Bawi Id., W Zanzibar; Kuwenga, Zanzibar; Mnumba Id., NE Zanzibar (all ANSP). KENYA: Jadini (BPBM). RED SEA: Strait of Jubal (ANSP). MADAGASCAR: Tulear; Soalara, 16 mi. S of Tulear (both MCZ); 28-34 mi., sandy mud, 32 mi. SW of Nossi Be (ANSP, MCZ). MAURITIUS: (AMNH, ANSP, USNM, RNHL); La Gaulette (USNM); G. Antilene (DMNH). MALDIVES: Hulele (ANSP). INDIA: Rameshwaram, Panban Id., Madras (USNM). CEYLON: (AMNH, ANSP). JAPAN: Kii, Honshu (AMNH); Tosa, Shikoku; Kashiwa Shima, W. Coast Kyushu (both DMNH); Okinawa, Ryukyus (ANSP, MCZ, USNM). MARIANAS: Guam (USNM); Cocos Id., SW Guam. PALAU ISLANDS: S of Ngeroi (both ANSP). CAROLINE ISLANDS: Ponape (MCZ). TAIWAN: off Kaohsiung (AMNH, USNM); off Anping; Pescadores (both ANSP). CHINA: Hongkong (DMNH); S of Lema Ids., Hongkong; 50-100 fms., E of Hainan (both ANSP). PHILIPPINES: Baler, Quezon, Luzon; W Paluan Bay, Mindoro (both USNM); Pola, Mindoro (MCZ); Calapan, Mindoro (AMNH, ANSP, MCZ); Tilig, Lubang, Mindoro (USNM); Silanguin Bay, Lubang, Mindoro; Cabra Id., Lubang, Mindoro (both MCZ); Capul Id., NW Samar (ANSP); Capiz, Panay (MCZ); Cebu City, Cebu (ANSP, USNM); Zamboanga, Mindanao (DMNH); Balabac (ANSP); Tubigan Id., Pangantaran Group (USNM); Jolo (ANSP); Laminusa Id., Siasi Id., Sulu Arch. (DMNH), Siasi Id. (MCZ, USNM); Bongao Channel, SW end Sanga Sanga Id., Sulu Arch. (ANSP). INDONESIA: Uleelhoue, Kutaradja, NW Sumatra; Bangka (both RNHL); Keledjidan, Bantam, Java; Tjerpwagaram, Bantam, Java (both USNM); Madura; Bali (both RNHL); Ampenan, Lombok (USNM); Timor; Wetar; Banda (both RNHL); Ambon (MCZ, RNHL); Maupaia, betw. Buru and Ceram; Ceram; Busak, N Celebes; Waigeo, W Irian; Fak-Fak, W Irian; Sekru, W Irian; Serocoi Bay, Japen, W

Irian; Biak, W Irian; (all RNHL). WESTERN AUSTRALIA: SW of Adele Id., off King Sound; off Troughton Island (both WAM); Darwin. NORTHERN TERRITORY: Yirrkala. QUEENSLAND: West Cay Diamond Islets; Palm Island (all AMS). ADMIRALTY ISLANDS: (NMV). BISMARCK ARCHIPELAGO: Tsoi Launung Id., betw. New Hanover and New Ireland (AMS); Duke of York Id. (RHNL); Rabaul, New Britain (AMNI, USNM); Matupit Id., Rabaul, New Britain; Kambulu, New Britain; Gumlung Id., New Britain (all ANSP). PAPUA: Goodenough Id. (AMNI, USNM). SOLOMON ISLANDS: Teop Id., Bougainville (AMNI); Gihili, Bougainville (AMS); Buin, Bougainville (ANSP); Buka Id., Bougainville (MCZ); Shortland Ids. (ANSP); Senga, Choiseul (AMNH); Kukodo, Gizo Id.; Kilapoda Reef, Vangunu Id., New Georgia (both ANSP); Ususue, Ata District, Malaita (AMNI, ANSP); Ugi Id., San Cristobal (USNM). NEW IEBRIDES: Lamap, Malekula (ANSP). NEW CALEDONIA: Bourail; Koumac (both ANSP). FIJI: Nadi Bay, Viti Levu (AMS); Suva Harbor, Viti Levu (USNM); Lau Ids. (MCZ). WALLIS ISLANDS: (MCZ). SAMOAN ISLANDS: Upolu (ANSP). TONGA: Monuafu Reef, Tongatapu (Colln. H. C. Gay); Niutoua Reef, Tongatapu (USNM). SOCIETY ISLANDS: Mataiea, Tahiti (ANSP); motu S of Faaroo Pass, Raiatea (DMNH). MARQUESAS ISLANDS: Uahuka (ANSP); 7 dredge hauls, 25-45 fms., Nukuhiva; 6 dredge hauls, 22-51 fms., Ua Pou; 6 dredge hauls, 30-46 fms., Taluata; 3 dredge hauls, 42-45 fms. Fatuhiva (all USNM). HAWAIIAN ISLANDS: Ewa Beach, Oahu (Colln. T. H. Richert); Waikiki, Oahu (USNM, Colln. T. H. Richert); Kailua Bay, Oahu (MCZ, Colln. C. S. Weaver); Makua, Oahu, in 40 ft. (DMNH); Barbers Point, Oahu (BPBM, Colln. C. S. Weaver); Keelii Lagoon, Oahu (BPBM, USNM, Colln. C. S. Weaver); Honohulu Harbor, Oahu; Kahana, Oahu; Lanai (all USNM); off Kihui, Maui (Weaver, 1963). JOHNSTON ISLAND: Sand Island (USNM).

Fossil Records—INDONESIA: S Bantam, Java; age: Pliocene (Oostingh, 1938); near Kroe, Benkoelen, S Sumatra; age: Upper Miocene (Zwierzycki, 1915, p. 105).

Harpa davidis Röding, 1798

(Pl. 187, figs. 4-6)

Range—Maldives, Ceylon and eastern India to Burma, Thailand, and northwestern Sumatra.

Remarks—This species, which appears to be restricted to the coasts surrounding the Bay of Bengal, has hitherto been confused and synonymized with *Harpa major* Lamarck and *articularis* Lamarck (Habe, 1964, p. 105, pl. 33, fig. 24). I question all records of this species purporting to be from the islands in the western Indian Ocean, such as Mauritius, and from the eastern part of Indonesia.

The most useful character to differentiate it from *Harpa major* and *articularis* is the form of the brown splotch on the parietal wall which in *davidis* has the upper larger portion bisected, or almost so, by a wedge-shaped clear area which may be prolonged into the aperture by a narrow dividing band. The lower portion of the parietal blotch is bisected resulting in an isolated brown or chestnut spot at the base of the columella.

In general shape and size *H. major* and *davidis*

are similar, but the body whorl of the latter is more broadly ovate and rounded, the ribs tend to be narrower and more distant, and usually have a series of single dark chestnut lines on the ribs. Juvenile specimens usually show fine but strong spiral cords of varying width; the names *H. cancellata* Röding and *H. striata* Lamarck are based on such specimens.

Habitat—Found crawling in the sand, just underneath the surface, in shallow water at Trincomalee, Ceylon. Also trawled in deeper water off the Indian coast (Crichton, 1941, p. 330).

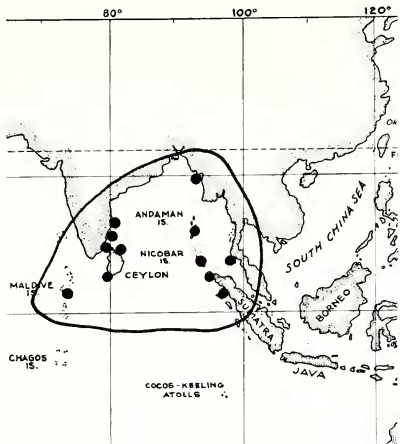
Description—Shell of moderate size, 47.5 to 90 mm. (1½ to 3½ inches) in length, broadly ovate with rather short, broadly conical spire. Protoconch elevated-mamillate, pale pink, of 3¼ to 3⅝ convex whorls. Early postnuclear whorls reticulated by axial riblets and spiral cords, moderately angulate at the shoulder; penultimate whorl and early part of antepenultimate whorl covered by extensions of earlier parietal calluses. Body whorl broadly inflated, with 10 to 12 axial ribs which are spinosely angulate at the shoulder below the subsutural shelf, and are generally narrower than in *H. major*; the ribs have areas of different shades of red brown or pale pink resulting from the spiral bands of the color pattern of the shell, and in addition generally dark chestnut lines that are single or closely double. Base color usually grayish pink and occasionally darker, showing a banded arrangement, and marked by axial sharply arcuate or sagittate streaks of red brown, most prominent in the area adaperatural of the ribs. Aperture broadly semilunate, inner lip very gently concave or almost straight, outer lip arcuately concave, parietal and columellar callus large, marked by large upper and middle blotches separated by a triangular area; a small basal blotch is present in the center of the callus covering the lower half of the columellar area; the anterior siphon is rather broad.

Measurements (mm.)—

| length | width | no. whorls | |
|--------|-------|------------|-------------------|
| 90.3 | 65.7 | 6 | large; Ceylon |
| 83.6 | 59.1 | 5½ | large; N. Sumatra |
| 63.4 | 43.8 | 5 | average; Ceylon |
| 55.4 | 39.1 | 5½ | average; Ceylon |
| 47.5 | 31.1 | 6½ | small; Andamans |

Synonymy—

- 1798 *Harpa davidis* Röding, Museum Boltenianum, pt. 2, p. 150, no. 1878; refers to Martini, Conchyl.-Cab., vol. 3, pl. 119, f. 1092 (Coronandell).
1798 *Harpa cancellata* Röding, loc. cit., p. 150, no. 1879; refers to Chemnitz, Conchyl.-Cab. vol. 10, pl. 152, f. 1453 (Tranquebar); 1857, Kiester, Conchyl.-Cab., (ed. 2), vol. 3, pt. 1B, p. 96, pl. 70, f. 4, 5.

Plate 216. Geographical distribution of *Harpa davidis* Röding.

- 1807 *Harpatis davidis* Link, Besch. Nat.-Samml. Univ. Rostock, pt. 3, p. 114.
- 1816 *Harpa striata* Lamarck, Liste in Tabl. Encycl. Meth., pt. 23, Moll. et Polypes Div., p. 3; refers to pl. 404, f. 4; 1822, Lamarck, Hist. Nat. An. s. Vert., vol. 7, p. 257 (no locality); 1883, Tryon, Man. Conch., vol. 5, p. 99, pl. 41, f. 74-75.
- 1852 *Harpa nablium* Mart., Mörch, Cat. Conch. Yoldi, pt. 1, p. 125 (no locality); 1860, Sowerby, Thes. Conch., vol. 3, p. 170 (in part), pl. 232, f. 15-16, pl. 233, f. 24; 1877, Sutor, Jahrb. deutsch. Malak. Ges., vol. 4, p. 107.
- 1857 *Harpa articularis* var. C. Küster, Conchyl.-Cab., ed. 2, vol. 3, pt. 1B, p. 87, pl. 70, f. 2.
- 1942 *Harpa conoidalis* Lam., Gravelly, Bull. Madras Govt. Museum, N. S., Nat. Hist. Section., vol. 5, no. 2, p. 67, f. 12h; 1952, Satyapurti, *op. cit.*, vol. 1, no. 2, pt. 6, p. 196, pl. 19, f. 1a, 1b. (not *conoidalis* Lam., 1822)

Types—Röding's name is based on a figure and description given by Martini (cited above), based in turn on specimens in his collection, the present location of which is unknown. Martini gives Coromandel as the provenance of his specimens; we further restrict the type locality to Madras, India. Similarly the specimen upon which *H. cancellata* Röding is based was not found in the collection of Zoological Museum in Copenhagen. The type of Lamarck's *H. striata* cannot be found in the Muséum d'Histoire Naturelle in Geneva.

Nomenclature—This species has been misunderstood by most authors and misidentified or synonymized with other species. I can find in Reeve's monograph (Reeve, 1843) no figures that with certainty can be identified with this species; unfortunately one cannot determine from most of his descriptions and figures the nature of the col-

mellar blotches. Tryon, in 1883, placed this species under *conoidalis* Lamarck. Sutor in the most perceptive study of the group to date (Sutor, 1877) describes as a distinct species *Harpa nablium* Martini, under which he cites the Martini figure which is the figure on which Röding based his *davidis*. Workers on the Indian fauna have usually used the name *H. conoidalis* Lam. (= *major* Röding) for this species. The shells that Habe (1961, p. 68, pl. 33, fig. 24. and 1964, p. 105, pl. 33, fig. 24) illustrates under *H. davidis* are not that species, being in one case (1961) *H. major* Röding, and in the other (1964) *H. articularis* Lamarck.

Records—MALDIVES: (BMNH): Elisabeth Pt. Triconmalee; Kacheri to Powder Bay, Triconmalee (both ANSP). INDIA: Rameshwaram, Pamban Id., Madras (USNM); Tranquebar (ZMC); Madras (BMNH, MICZ, USNM, ZMC). ANDAMANS (ZMC). NICOBAR IDS.: (ZMC). BURMA: 17 mi. SE of Akyab (ANSP). THAILAND: Ko Phuket (ANSP). INDONESIA: Sumatra, NW Atjeh; nr. Kutaradja, Atjeh, Tapatocan, Atjeh (all RNH).

Harpa articularis Lamarck, 1822

(Pl. 188, figs. 5-7; Pl. 217)

Range—Philippines and Indonesia to Western Australia, Queensland, and Fiji.

Remarks—This easily recognized species is characterized by its broadly ovate shape, relatively narrow ribs strongly marked with dark chestnut lines, and particularly by the large chestnut ventral splotch which covers the whole thin parietal and columellar calluses, with the slender ribs on the ventral side showing through the splotch. The overall pattern of markings between the ribs is more subdued and semi-obscure than in the other species.

The geographical range of this species is rather restricted, as a glance at the distributional map shows. It also appears to have a geological history, as a specimen figured as *Harpa conoidalis* Lamarck ? by Martin (1879-80, p. 41, pl. 8, fig. 1) is so close in appearance to *Harpa articularis* that I am assigning it here.

Description—Adult shell 41 to 96 mm. (1½ to 3¾ inches) in length, broadly ovate, usually rather thin, last whorl large, broadly ovate, spire broadly conical. Nuclear whorls conical, 3½ in number, rounded, smooth, flesh-colored or darker. Early postnuclear whorls with two or three spiral cords and many strong lamellose axial ribs that are made strongly and angularly denticulate at the shoulder, accentuated by the presence of a shallow groove just below the shoulder of the whorls. The antepenultimate whorl has the lower half

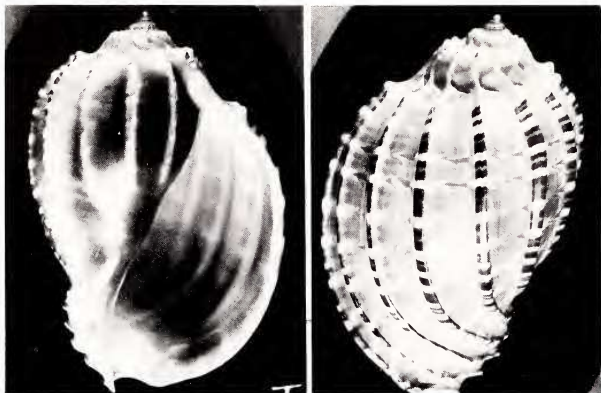


Plate 217. *Harpa articularis* Lamarck, 1816. Holotype. Muséum d'Histoire Naturelle, Genève. 70 mm.

covered by a glaze, while the penultimate whorl is wholly covered by the glaze formed by the extension of former parietal calluses. Last whorl of larger specimens with 12 to 16, usually rather narrow ribs, strongly marked by dark chestnut lines that are usually in groups. Color of shell varies from pinkish or brownish flesh-colored to reddish grayish brown, with a more or less obscure pattern of spiral bands of white and axial, zigzag, darker lines with high sharp peaks where they cross the white bands, forming there a series of sagittate markings. Aperture oval, posteriorly acuminate, outer lip evenly rounded, ventral surface of body whorl covered by an uninterrupted chestnut colored parietal glaze, with only the axial ribs showing through; callus at posterior junction of outer lip white. Interior of outer lip is pale below the junction with the body whorl and in the anterior canal area.

The animal of a specimen from Virac, Catanduanes, Philippines, is paler in color than that of *H. major*, distantly spotted with reddish brown and the anterior edge of the propodium is gently undulate.

Measurements (mm.)—

| length | width | no. whorls | |
|--------|-------|------------|-----------------------------------|
| 95.6 | 63.8 | 6½ | large; Philippines |
| 92.6 | 60.4 | 6½ | large; Adele Id., W Australia |
| 74.2 | 51.4 | 6½ | average; Tim Can Bay, Queensland |
| 67.8 | 45.0 | 7½ | average; Catanduanes, Philippines |
| 49.6 | 32.2 | 5½ | small; Philippines |
| 40.9 | 27.1 | 5½ | small; Tambisan, North Borneo |

Synonymy—

- 1811 *Harpa delicata* Perry, Conchology, pl. 40, fig. 2 [*nomen oblitum*]
 1816 *Harpa nobilis* Lamarck, Liste, Tabl. Encycl. Method., pt. 23, Moll. et Polypes Divers., p. 3; refers to Encycl. Method. Moll. Test., pl. 404, fig. 3a, b (no locality). Not *Harpa nobilis* Röding, 1798.
 1822 *Harpa articularis* Lamarck, Hist. Nat. Anim. sans Vert., vol. 7, p. 256 (no locality); 1835, Kiener, Spec. Gen. Icon. Coq. Viv., vol. 8, Genre Harpe, p. 8, pl. 2, fig. 3; 1843, Reeve, Conch. Icon., vol. 1, *Harpa*, pl. 2, fig. 4d; 1857, Küster, Neues Syst. Conch.-Cabs., ed. 2, vol. 3, pt. 1, p. 87, pl. 66, figs. 3-5; 1877, Sutor, Jahrb. deutsch. Malak Ges., vol. 4, p. 102, pl. 5, fig. 3.
 1964 *Harpa davidis* Röding, Habe, Shells of the Western Pacific in Colour, vol. 2, p. 105, pl. 33, fig. 23. Not *H. davidis* Röding, 1798.
 1966 *Harpa davidis* Röding, Habe and Kosuge, Shells of the World in Colour, vol. 2, p. 79, pl. 30, fig. 1. Not *H. davidis* Röding, 1798.

Types—I found two specimens labeled *articularis* in the collections of the Muséum d'Histoire naturelle de Genève, of which I have chosen as lectotype the specimen illustrated in Plate 217.

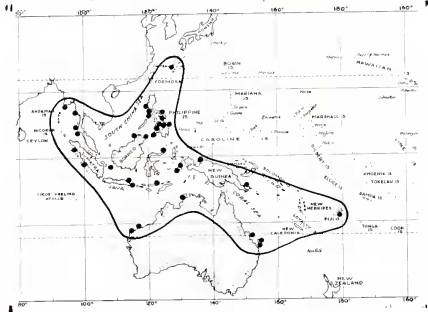


Plate 218. Geographical distribution of *Harpa articularis* Lamarck.

Records—JAPAN: Okinawa, Ryukyus (ANSP). PHILIPPINES: Iba, Zambales, Luzon; Mariveles, Bataan, Luzon; Corregidor Id., Luzon; Calatagan, Batangas, Luzon (all ANSP); Ternata, Cavite, Luzon (USNM); Lubang Id., Mindoro (ANSP, MCZ, USNM); Calapan, Mindoro (AMNH, ANSP, MCZ); Puerto Galera, Mindoro (AMNH, MCZ); Virac, Catanduanes (USNM); Ticao (AMNH); Maqueda Bay, Samar (MCZ); Capul Id., NW Samar (ANSP); Cebu City, Cebu (ANSP, USNM); Dumaguete, Negros; W of Bucas Grande Id., Siargao, Mindanao (both USNM); Mambajao, Camiguin Id., Mindanao (ANSP); Zamboanga, Mindanao (DMNH). BURMA: 50 mi. SW of mouth Irawaddy River, Prepara N. Channel, 53 m.; 57 mi. NW of Tavoy Id., 39 m. (both ANSP). THAILAND: Andaman Sea, 55 mi. W of Ranong, 73 m.; South end Pa Tong Bay, Ko Phuket (both ANSP). MALAYSIA: off Tambisan, North Borneo (USNM); Sapi Id., nr. Jesselton, North Borneo (ANSP). INDONESIA: Tapaktuan, Atjeh, NW Sumatra, Padang, Sumatra; Belitung, Madura (all BNIL); Bali (MCZ); Larantuka, Flores; Ceram; Ambon; Manado, Celebes (all RNIL); Samberbata, Japen Id., Geelvink Baai, W Irian (ANSP). PAPUA-NEW GUINEA: Goodenough Id. (AMNH). WESTERN AUSTRALIA: Exmouth Gulf; Adele Id.; Legendre and Delambre Ids., Dampier Archipelago (all WAM). NORTHERN TERRITORY: near Darwin (ANSP). QUEENSLAND: Keppel Bay, 20 fms. (AMS); Tin Can Id. (USNM); off Tin Can Bay, SE of Fraser Id., 30-35 fms. (AMS, DMNH, WAM, NMV); E of Fraser Id. in 30 fms. (DMNH). FIJI: Ngau Id. (BM).

Fossil Records—INDONESIA: north of Sindangaran, S coast of western Java; age: Upper Miocene; Tjlanang beds (Martin, 1879-80, p. 41).

Harpa ventricosa Lamarck, 1816

(Pl. 188, figs. 1, 2; Pl. 219)

Range—Red Sea and East Africa to Seychelles and Mauritius.

Remarks—This species occurs in the western part of the Indian Ocean. References to its occur-

rence in India, Indonesia, and the Philippines are to be regarded as doubtful, and are based on old specimens in museum collections (see under "Records"), or based on the use of this name for what is now known as *H. major* Röding.

Compared to its closest relative, *Harpa major* Röding, *H. ventricosa* is characterized by the squarish aspect of the body whorl when viewed from the apertural side, the flattened side and angulate shoulder where the ribs are more erect and bear a strong triangular spine with less conspicuous spines below the shoulder. The chestnut intercostal painting is more regularly, deeply, and multiplicately arcuate; the chestnut markings on the parietal wall are decidedly less extensive.

Habitat—In 0 to 15 feet, on sandy bottom; in one locality on the southwest coast of Nosy Be, Madagascar, it is recorded as living in the marine "grass" *Cymodocea*.

Description—Shell 48 to 110 mm. (1¾ to 4¼ inches) in length, broadly oval, with left side rather flattened when viewed from apertural side, solid, body whorl large. Spire conical; protoconch elevated-conical, flesh-pink, 4¼ whorls, smooth; earliest portion of first postnuclear whorl without spiral cords and with several distant prosocline, shallow-sigmoidal riblets, succeeding portions angulated by several spiral cords that cross the riblets, which become increasingly lamellar; the ribs at the uppermost, subsutural cord form a conspicuous projection. The lower portion



Plate 219. Two views of the holotype of *Harpa ventricosa* Lamarck, 1816. This specimen was illustrated in the Encyclo-

pédie Méthodique, vol. 3, pl. 404, figs. 1a, 1b. Photo by G. Dajoz, courtesy of Muséum d'Histoire Naturelle Genève.

of the spire whorls becomes increasingly covered by a glaze which is the remaining visible portion of the succeeding parietal glazes; the projections at the junctions of the axial ribs with the subsutural cords becomes distinctly spinose towards the end of the penultimate whorl; throughout the spire very fine axial threads are present between the ribs; irregular chestnut or pale brown spots are present below the sutures of the spire whorls. Body whorl large with a variable number of ribs flattened below the shoulder; the ribs bear one strong lamellar dentate projection at the subsutural ridge, and one, and occasionally more, less elevated, angular projections at the succeeding obscure spiral cords; the ribs are marked by blotches of varying shades of flesh-color separated by narrow bands of white, all aligned as revolving bands on the body whorl; the interspaces, which are sculptured with fine axial threads, are marked by festoonlike chestnut lines, and occasional chestnut blotches; in some dark-colored shells the coloration on the ribs is of a red-brown or orange shade. The parietal wall is covered with a thin glaze marked by two large chestnut spots, one near the junction of the outer lip and body whorl and the other where the columellar lip joins

the parietal wall. A third small spot is present at the base of the columellar lip and is occasionally connected to the lower large spot by a chestnut patch along the inner edge of the columellar lip. Aperture ovate, outer lip gently rounded or occasionally somewhat flattened; interior usually with yellow-orange coloration, and with the external banded pattern visible.

Measurements (mm.).—

| length | width | no. whorls | |
|--------|-------|------------|--------------------|
| 108.8 | 78.3 | | large; Mauritius |
| 99.5 | 67.7 | 7½ | large; Seychelles |
| 85.3 | 58.4 | 8 | average; Mauritius |
| 55.3 | 38.7 | 6½ | small; Zanzibar |
| 47.8 | 32.6 | | small; Zanzibar |

Synonymy—

- 1816 *Harpa ventricosa* Lamarck, Encyclopédie Méthodique, vol. 3, pl. 404, figs. 1a, 1b., Liste, p. 3; 1822, Lamarck, Hist. Nat. Anim. sans Vert., vol. 7, p. 255 (Mers des Indes orientales); 1835, Kiener, Coquilles Vivantes, vol. 8, Gen. *Harpe*, p. 6 (in part), pl. 1, fig. 1, pl. 4, fig. 7; 1843, Reeve, Conchologia Iconica, vol. 1, *Harpa*, pl. 1, sp. 2 (in part: figs. 2b, 2c, 2d only); 1857, Küster, Neues Syst. Conch.-Cabinet, ed. 2, vol. 3, pt. 1, p. 89, pl. 67, figs. 1-3; 1860, Sowerby, Thesaurus Conchologia, vol. 3, p. 169 (in part), pl. 232, figs. 18-22, pl. 233, fig. 25; 1877, Sutor, Jahrb. deutsch. Malak. Ges., vol. 4, p. 99.
- 1822 *Buccinum harpa* var *testudo* Donovan, Naturalist's Repository, Exotic Natural History, vol. 1, pl. 8. Not *B. testudo* Lightfoot, 1786, a nomen dubium.
- 1843 *Harpa conoidalis* Lamarck, Reeve, Conchologia Iconica, vol. 1, *Harpa*, pl. 3, sp. 7 (in part): fig. 7b only; not *Harpa conoidalis* Lamarck, 1822).
- 1860 *Harpa cabritii* Fischer, Journ. de Conch. vol. 8, p. 209, pl. 4, figs. 1, 2 (juvenile) (no locality).
- 1948 *Harpa major* Röding, M. Smith, Triton, Helmet and Harp Shells, p. 48 (in part), pl. 16, fig. 7 (not *Harpa major* Röding, 1798).

Types—In the Museum d'Histoire Naturelle in Geneva no specimens were found in the Lamarck Collection that agree exactly with the figure in the Encyclopédie Méthodique. In the Delessert Collection, however, I found a specimen that agrees with the above-mentioned figure but is slightly smaller (96 mm. in height instead of 100.4). This specimen I designate as the neotype. The type of *H. cabritii* Fischer is in the British Museum (Natural History), catalogue number B. M. (N. H.) 99.8.22.126. The whereabouts of the type of *H. testudo* Donovan is not known.

Records—SOUTH AFRICA: off Durban, Natal, from fish (Colln. Helen Boswell). MOZAMBIQUE: Moçambique (ANSP, BM, CMNH); Porto Amelia (AMNH, DMNH, MCZ). TANZANIA: Dar es Salaam (MNH); Mijimwenda, 5 mi. ESE of Dar es Salaam (MCZ); Zanzibar (ANSP, BM, DMNH, MCZ, RNH); Kivengwa, in 0 to 10 ft.; Chumbe Id., 0 to 6 ft.; Pange Id., 0 to 2½ ft.; Mneemba Id.; 2 mi. W of Bani Id., 15 fms. (all Zanzibar and ANSP). KENYA: Mombasa (BM); Diani Beach; Lamu Id. (both MCZ); Tiwi (MHNC); RED SEA Straits of

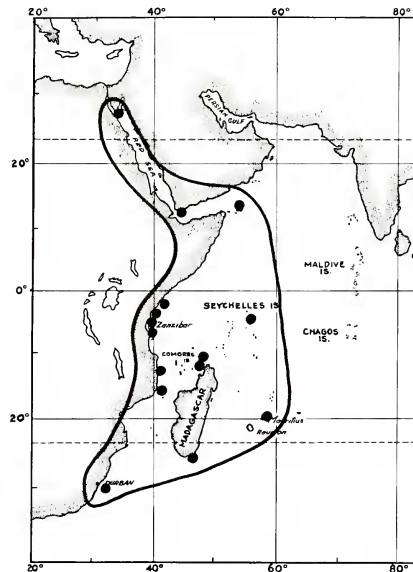


Plate 220. Geographical distribution of *Harpa ventricosa* Lamarck.

Jubal (ANSP). ADEN (BM). SOCOTRA: north coast (ANSP). MADAGASCAR: between Ambotoloaka and Madioranokely, SW of Nosy Bé; Amforah, Nosy Be (both ANSP); S of Ambovombe (AMNH); Nosy Faly (FNHL). ILE GLORIEUSE: (USNM). SEYCHELLES: (MCZ); Mahe (BM). MAURITIUS: (AMNH, ANSP, BM, DMNH, MCZ, USNM); Mahebourg (USNM); Ile Flamand (DMNH).

Doubtful Records—Tranquebar Coast, India (RNHL); Madura (RNHL) and Ambon, Indonesia (MCZ, RNHL); these three records are based on specimens from old collections, and should be regarded as doubtful. No specimens of this species have been found in India or Indonesia in recent years. Two specimens in the USNM are labeled as coming from Luzon and from Negros Oriental; the localities of these specimens, obtained from a dealer and from an amateur collector respectively, are suspect.

Harpa costata (Linné, 1758)

(Pl. 187, figs. 1-3; Pls. 221-223)

Range—Islands of the western Indian Ocean: Mauritius, Rodrigues, and northeastern Madagascar.

Remarks—This is one of the most distinctive species, characterized by its broad shape, the large number of crowded ribs, which are rather sharply pointed at the shoulder-angle of the body whorl forming a broad subsutural channel; its distinctive coloration consists of numerous spiral bands of varying shades of flesh color and white.

Habitat—On sand banks, frequently in shallow water—10 inches to 6 feet.

Description—Shell 70 to 100 mm. (2¾ to 4 inches) in length, broadly subquadrate, solid, last whorl very large. Spire broadly conical; protoconch elevated-conical, flesh pink, whorls 4½, smooth; early postnuclear whorls broadly shouldered, with spaced axial riblets and fine spiral cords below the shoulder and light chestnut spots on the shoulder between the protractively curved riblets. On the later postnuclear whorls the axial riblets become more crowded, and on the shoulder become increasingly lamellar towards the upper portion where they are adnate to the preceding whorls, fusing and covering the lower half of the exposed whorls; in the last half of the penultimate whorl the spiral cords become obscure, in some specimens completely covered by the fused upper part of the ribs of the following whorl. On the body whorl the ribs are crowded, shiny, 30 to 40 and more in number, depending on the size of the shell; they are lamellar, recurved, with a triangular, spinelike projection at the shoulder angle, forming a broad, subsutural channel; often more or less flattened in the last half of the body whorl, and fused above the conspicuous siphonal fasciole over which the lamellar

ribs are strongly continued. Between the ribs are fine axial cords crossed by distant, subobscure spiral cords. External color of shell pale flesh color, with bands of varying darker shades and white; occasional subquadrate spots of chestnut color are present between the ribs, usually in an irregular peripheral band. Aperture broad, appearing subrectangular because of the broad subsutural shelf; inner lip almost straight, outer lip angled at the shoulder and rather effuse at the base, slightly thickened within; parietal callus rather thin, columellar callus heavier, both usually somewhat suffused with yellow, and with three chestnut blotches, the upper and middle ones moderately large, generally subequal, the lower one on the columellar callus small, obscure or absent; interior of aperture often with a yellow wash, especially near the base.

From color slides kindly sent me by Mrs. E. Couacaud of Port Louis, Mauritius, (Plate 221) the foot of *H. costata* appears to be relatively broader than in either *ventricosa* or *major*, and the posterior end is rather obtuse with a keel marking the posterior part of the foot.



Plate 221. Dorsal view of *Harpa costata* (Linné) from Mauritius (photo by Mrs. E. Couacaud).

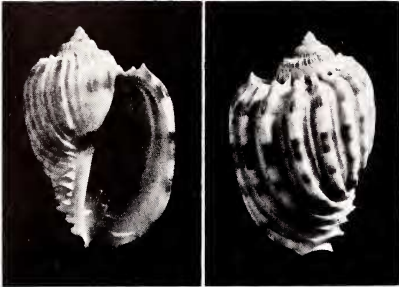


Plate 222. *Harpa costata* (Linné) Holotype of *Harpa costata* var. *laetifica* Melvill, 1916. National Museum Wales. 42.1 mm. in length.

Measurements (mm.)—

| length | width | no. whorls | |
|--------|-------|------------|--------------------------------------|
| 99.0 | 78.0 | | large; Mauritius |
| 97.4 | 69.4 | | large; Ile aux Fouquets, Mauritius |
| 92.0 | 67.2 | 6% | average; Le Morne, Mauritius |
| 85.1 | 61.0 | | average; Ile aux Fouquets, Mauritius |
| 81.8 | 63.9 | | average; Ile aux Fouquets, Mauritius |
| 71.3 | 54.8 | 6% | small; Mauritius |

Synonymy—

- 1758 *Buccinum costatum* Linné, *Systema Naturae*, ed. 10, vol. 1, p. 738 (no locality); type locality here designated: Mauritius.
- [1788 *Harpa imperialis* Chemnitz, *Conchylien-Cabinet*, vol. 10, p. 184, pl. 152, fig. 1452 (no locality); non-binominal.]
- 1822 *Harpa imperialis* Lamarck, *Hist. Anim. sans Vert.*, vol. 7, p. 225 (Mers de l'Amerique meridionale?); 1853, Chenu, *Illustr. Conchyliologiques*, vol. 4, pt. 85, *Harpa*, pl. 1, fig. 1, la, lb.
- 1822 *Harpa multicostata* Sowerby, *Genera of Shells*, no. 3, *Harpa*, fig. 1 (Indian Ocean).
- 1835 *Harpa ventricosa* var. Kiener, *Coquilles Vivantes*, vol. 8, *Genre Harpe*, p. 7, pl. 2, fig. 2 (no locality).
- 1843 *Harpa imperialis* Chemn., Reeve, *Conchologia Iconica*, vol. 1, *Harpa*, pl. 2, fig. 5; 1857, Küster, *Neues Syst. Conchylien-Cabinet*, ed. 2, vol. 3, pt. 1B, p. 86, pl. 66, figs. 1-2, pl. 70, fig. 1.
- 1860 *Harpa costata* Linné, Sowerby, *Thesaurus Conchologica*, vol. 3, p. 169, pl. 231, figs. 4-5, pl. 233, fig. 23 (young); 1883, Tryon, *Man. of Conch.*, vol. 5, p. 97, pl. 40, fig. 58.
- 1877 *Harpa costata* var. *gruneri* 'Maltzan' Sutor, *Jahrb. deutsch. Malak. Gesellschaft*, vol. 4, p. 102, pl. 4, fig. 2 (no locality).
- 1916 *Harpa costata* var. *laetifica* Melvill, *Journ. of Conch.*, vol. 15, p. 31 (no locality).

Types—There is no specimen of this species in the Linnean Collection in London, and Linnaeus did not cite any reference in his original description. According to Odhner (unpublished list and microfilm) a specimen is present in the Museum Ludovicae Ulricae, and this specimen I hereby designate as lectotype. The type locality I am designating as Mauritius. The specimen upon which Chemnitz based his description and figure of his *Harpa imperialis* and which he stated came "Ex Museo Spengleriano" is present in the Zoological Museum in Copenhagen with a label in Spengler's handwriting. This specimen I am designating as the lectotype of Lamarck's species *imperialis*; there are no specimens of *H. imperialis* in the Lamarck collection in Geneva. The type of *gruneri* Sutor was in the Maltzan collection which according to Dance (1966, p. 293) was purchased by a dealer and dispersed; its present location is unknown. The holotype of Melvill's variety *laetifica* is in the Melvill-Tomlin Collection in the National Museum of Wales in Cardiff (Plate 222).

Records—MAURITIUS: Le Morne, SW coast (DMNH, USNM); off Ile Marianne and Ile aux Fouquets, W coast (ANSP, Colln. W. N. Carpenter); Mahebourg (ANSP, DMNH); Les Bénitiers, W coast (AMNH). RODRIGUES (BM). MADAGASCAR: 28 km. S of Antalaha, NE coast, in 2 meters (Mme. H. Bouchard, in litt.).

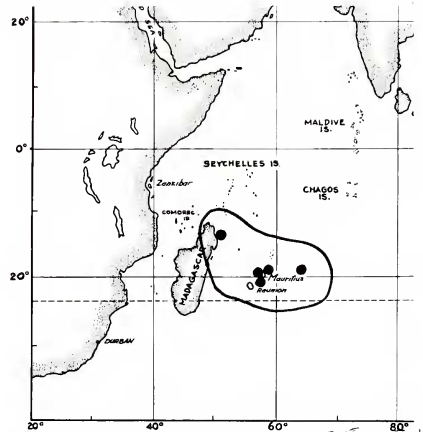


Plate 223. Geographical distribution of *Harpa costata* (Linné).

Harpa doris Rödning, 1798

(Pl. 189, figs. 12-16; Pl. 224)

Range—From the Cape Verde Islands to Luanda, Angola; Ascension Island.

Remarks—*Harpa doris* is most closely related to the only other species found outside of the Indo-Pacific region, namely *Harpa crenata* Swainson of the Panamic province. This relationship is demonstrated by the presence in both species of vivid, spirally oriented, narrow bands of color markings, often in a more or less sagittate pattern, as well as blotches of solid color; in fresh specimens of both species the ribs are marked on their abapertural side by a fine, interrupted chestnut line. *Harpa doris*, differs from *crenata* in being smaller, somewhat more slender, the ribs with a greater tendency to becoming broad, and by the spirally oriented series of blotches being rose or rose-orange rather than chestnut.

Description—Shell 77 to 31 mm. (3 to 1¼ inches)

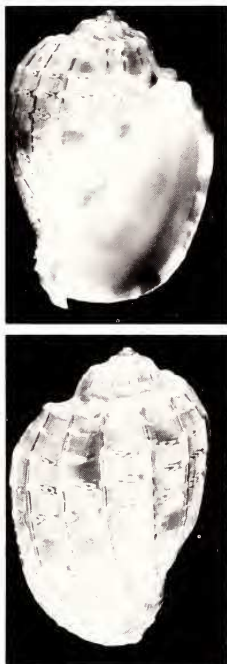


Plate 224. *Harpa doris* Rödning. Holotype of *Harpa rosca* Lamarck, 1816. Muséum d'Histoire Naturelle (Genève), 55 mm. in length.

in length, usually elongately oval and rather thin, but occasionally broader and solid. Spire broadly conical; protoconch elevated-mamillate, 3¼ whorls, pale pink or flesh-color, smooth; first 1½ postnuclear whorls with low, sharp axial ribs crossing distant rounded spiral ridges; between the ribs the spiral sculpture is crossed by crowded microscopic axial threads. On subsequent whorls the ribs show a spinose angulation at the shoulder, and the spiral sculpture becomes increasingly obscure, first on the subsutural ramp above the shoulder, and then on the remainder of the whorl. Body whorl elongate ovate, with a distinct subsutural shelf above the shoulder angulation which is marked by the strong triangular spines of the ribs; ribs 11 to 13, occasionally 14, in number, generally slender and rather low, and triangular in cross-section; occasionally those towards the aperture are greatly broadened; ribs marked by a thin brown interrupted line on the crest. In the stout broad form, all the ribs on the body whorl are rather broad and heavy and rather angulate at the periphery. Base color pale flesh-pink, occasionally darker, with the early postnuclear whorls orange-pink to purplish pink; bands of this color are present on the body whorl below the angulation at the shoulder, in the middle of the whorl, and above the base, the latter narrower than the other two; these bands often are bicolorous with alternate squarish blotches of the orange shade and the purplish pink shade; narrow, subequally spaced bands of chestnut marked by sagittate white spots mark the body whorl, these bands occasionally linked by obscure, chestnut, arcuate lines. A thin glaze covers the parietal and columellar areas which are marked by three separated brown spots: one just above the juncture of the

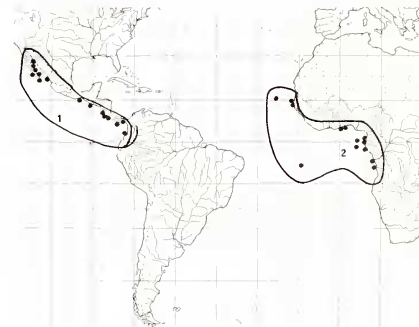


Plate 225. Geographical distribution of: 1. *Harpa crenata* Swainson. 2. *Harpa doris* Rödning.

outer lip with the body whorl, another, the largest, just above where the columella joins the parietal wall, and the third on the expanded columellar lip; the last two spots are separated by the covered siphonal fasciole. Aperture elongate-ovate, semi-lunate, the outer lip gently arcuate.

Measurements (mm).—

| length | width | no. whorls | |
|--------|-------|------------|-------------------------|
| 77.2 | 49.8 | 6½ | large; Senegal |
| 49.7 | 29.0 | 7½ | medium; Cape Verde Ids. |
| 48.1 | 29.5 | | medium; Cape Verde Ids. |
| 40.1 | 25.2 | | small; Annobón |
| 31.1 | 20.6 | | small; Fernando Poo |

Synonymy—

- [1786 *Buccinum pandura* 'Solander' Lightfoot, Portland Catalogue, pp. 17, 103 (Guinea). *nomen nudum*].
 1798 *Harpa doris* Röding, Museum Boltenianum, p. 150; refers to Martin, Conchylien-Cabinet, vol. 3, p. 419, pl. 119, fig. 1094 (no locality given; type locality here designated: Accra, Ghana); 1948, M. Smith, Triton Helmet and Harp Shells, p. 47, pl. 16, fig. 4.
 1807 *Harpalis doris* Link, Beschreibung Naturalien Sammlung Univ. Rostock, pt. 3, p. 114.
 1816 *Harpa rosea* Lamarck, Encyclopédie Méthodique, vol. 3, pl. 404, fig. 2; Liste, p. 3; 1822, Lamarck Hist. Nat. Anim. sans Vert., vol. 7, p. 257; 1843, Reeve, Conchologia Iconica, vol. 1, *Harpa*, pl. 4, figs. 8a, b, c, d; 1950, Nicklès, Mollusques Testacés Marins Côte Occid. d'Afrique, p. 113, fig. 204.

*Types—*Röding based the species *doris* on a description and figure published by Martini, based in turn on a shell in the latter's collection. This specimen must be presumed to be lost. The type of *H. rosea* Lamarck is in the Lamarck Collection in the Museum of Natural History in Geneva.

*Records—*CAPE VERDE ISLANDS: (AMNH, BM, DMNH, MCZ). SENEGAL: (AMNH, BM, DMNH, RMIL). GAMBIA: (AMNH). GHANA: (BM); Accra (AMNH); Takoradi; Elmina (both Buchanan, 1954). SPANISH EQUATORIAL AFRICA: Santa Isabel, Fernando Poo (USNM); Corisco, Rio Muni (AMNH); Annobón (USNM). SAO TOME: (Knudsen, 1956). CABON: Ombouc (= Nammo, Ferman-Vaz, (Nicklès, 1952); ANGOLA: Santo Antonio de Zaire (Tomlin and Shackelford, 1914); Luanda (MCZ), ASCENSION ISLAND: (DMNH, MCZ); English Harbour (Colln. K. Jourdan); Georgetown Beach, (DMNH).

The form generally found washed up on the beaches of Ascension Island is a broader, heavier shell, with broader ribs that are more or less angulate at the periphery (Pl. 189, figs. 15, 16). I have seen two specimens from Santa Isabel on Fernando Poo that also belong to this form. For a time I considered this stout form to be a distinct subspecies restricted to the islands off the African coast. However, I have recently seen a fresh specimen of the normal form washed up on the sandy beach at English Harbour on Ascension Island. This is one of the few localities on the island where a sandy substrate is present. It is likely therefore

that the normal form occurs where a sand bottom is found, and that in a rocky area where the bottom consists of rocks or cobbles, as in most of Ascension Island and on Fernando Poo, the species develops a heavier shell. The two forms can thus be considered ecophenotypes of the species *Harpa doris* Röding.

***Harpa brochoni* 'Benoist' Cossmann, 1899**

(Pl. 226)

*Range—*Late Lower Miocene of France (Burdigalian).

*Remarks—*This species is a typical *Harpa*, as evidenced by the strong development of the parietal callus over the ventral surface of the body whorl and over the lower part of the penultimate whorl. Its closest relative is the West African *Harpa rosea* Röding, some of whose beachworm specimens closely resemble *H. brochoni*. The aperture of the latter is shorter, however, with the base less patulous, and the knobbing at the shoulder angle is heavier.

Description—(translated from Peyrot, 1928)—Shell thick. Size rather large. Form ventricose; spire short, composed of five to six whorls, the first smooth, constituting the protoconch which is badly preserved on my specimens; the following whorls, first convex, then angulate, are ornamented with a dozen narrow axial ribs, widely separated, subspinose on the angle; from the penultimate whorl they cross the suture and join each other on the preceding whorl; last whorl very large, ventricose, the ribs on it becoming heavy and lamellose; they cross posteriorly the sutural ramp extending onto the preceding whorl while joining each other; anteriorly they curve backwards hook-shaped over the siphonal fasciole, which thus appears strongly lamellose; the intercostal spaces show feeble separated spiral striae.



Plate 226. *Harpa brochoni* 'Benoist' Cossmann, 1899. Lower Miocene of France. 55 mm. (from Peyrot, 1928 pl. 11, figs. 30-32).

Aperture very dilated, above all anteriorly where it is strongly sinuate; outer lip rectilinear, slightly oblique, with a weak sinus at its junction with the suture, externally thickened by the last rib; internally smooth; columellar margin extensively spread over the ventral surface of the last whorl where it is rather thin, becoming thicker anteriorly where it forms a slight swelling on the edge of the siphonal fasciole, in the columellar area, before terminating in a point on the siphonal notch. Dimensions: height, 55 mm.; max. diam. 34 mm.

Synonymy—

- [1884 *Harpa brochoni* Benoist, Procès-Verbaux Soc. Linn. Bordeaux, 1884, p. LXXII, nom. nud.]
 1899 *Harpa brochoni* Benoist, Cossmann, Essais, paléococh. comp., livr. 3, pp. 74, 75, pl. 4, fig. 3 (near Bordeaux, France).
 1928 *Harpa brochoni* Benoist, Peyrot, Conch. Néogénique Aquitaine, vol. 5, p. 369, pl. 11, figs. 30-32 (Saucats, S of Bordeaux).

Harpa josephinae Sacco, 1890

(Pl. 227)

Range—Middle Miocene of northern Italy (Helvetian).

Remarks—This small species (19 mm. in length) is compared by the author with *Harpa ventricosa* Lamarck but it is more slender, not as broad as either *ventricosa* Lamarck or *major* Röding. In fact it resembles more closely *Harpa doris* Röding of West Africa, but the ribs are more numerous and are not as spinose below the subsutural ramp, and the body whorl does not show the angulation below the spinose shoulder of that species. The lack of the expanded parietal callus typical of *Harpa* may be due to the possible juvenile condition of the unique holotype.

Description (freely translated from the original)—The following comments distinguish this species from *H. bellardii*:

Shell smaller, very slightly more ovate. Ribs stouter (especially at the base), less elevated, occasionally less numerous; near the suture slightly flattened, above the base generally more widely

separated. Transverse striae nearly obsolete above, below very few, occasionally crossing the ribs. Aperture slightly wider, especially below. Siphon a little broader. Height 19 mm., width 12 mm.

Synonymy—

- 1890 *Harpa josephinae* Sacco, Moll. Terr. Terz. Piemonte e Liguria, pt. 7, p. 9, pl. 1, fig. 2a, b (Helvetian of hills near Turin).

Harpa americana Pilsbry, 1922

(Pl. 225)

Range—Middle Miocene of the Dominican Republic and southern Vera Cruz, Mexico.

Remarks—This species is, as Pilsbry states, close to *Harpa doris* Röding of the West African fauna, differing in the aperture being narrower anteriorly and in possessing conspicuous fine spiral striation between the ribs; the spiral striation in *doris* is visible only in certain specimens and even then is rather obscure. *H. americana* agrees rather closely with *H. josephinae* Sacco of the Miocene of northern Italy, although the spiral striation is more pronounced in the American species, and the ribs are more spinose at the shoulder.

Through the kindness of Dr. Horace C. Richards I have been able to examine the holotype of *Harpa americana*. As the figure given by Pilsbry agrees in all particulars with the type, and as it clearly shows the essential characters I have reproduced this illustration rather than give a photograph of the type.

The characters of the nuclear whorls are not described by Pilsbry nor shown clearly in his figure. The protoconch is erect-mamillate with the first whorl lost; the first 1½ of the remaining



Plate 227. *Harpa josephinae* Sacco, 1890. Miocene of northern Italy. 19 mm. (from Sacco, 1890, pt. 1, figs. 2a, 2b).



Plate 225. *Harpa americana* Pilsbry, 1922. Middle Miocene of Dominican Republic. 33.3 mm. (from Pilsbry, 1922, pl. 23, fig. 13).

whorls shows the basal keel just at the suture that is typical of the protoconch of the genus *Harpa*.

The measurement of the width of the type given by Pilsbry is in error; the true figure is given below following the description.

Perrilliat (1960, p. 24) describes and figures a slightly larger specimen collected in southern Vera Cruz, 11 kilometers east of Coatzacoalcos; this and another specimen mentioned by her, measure respectively 41 and 37 mm. in height. A smaller shell from the same locality, 26.0 mm. high, is in the collections of the U.S. Geological Survey.

Description (copied from Pilsbry)—The shell is ovate, of about 6 whorls, of which three smooth ones form the nipple-shaped embryonic shell, the last whorl of which, together with part of the first sculptured whorl, are very narrow. The last whorl has about eleven low and narrow axial ribs which rise into small spines where they pass over the angle bounding a narrow flattening below the suture. The whole surface below this angle is spirally striate, the striation strongest in the concavity of the sides below. The aperture is narrow for this genus. A thin callus spreads forward over the ventral convexity.

Length 33.3 mm., width 19.4, Dominican Republic. Holotype, ANSP 4061; length 26.0 mm., width 16.3 mm., Coatzacoalcos-Villa Hermosa Highway, Vera Cruz, Mexico, USGS Colln.

Synonymy—

- 1877 *Harpa rosea* Lam., Gabb, Trans. American Phil. Society, vol. 15, p. 214. Not *H. rosea* Lamarck, 1816.
 1922 *Harpa americana* Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, 1921, p. 337, pl. 23, fig. 13; 1960, Perrilliat, Paleontologia Mexicana No. 8, p. 24, pl. 3, figs. 18, 19.

Harpa crenata Swainson, 1822

(Pl. 189, figs. 1, 2; Pl. 225)

Range—Magdalena Bay, Baja California and southern part of Gulf of California, Mexico, to Gorgona Island, Colombia.

Remarks—This species is most closely related to *Harpa doris* Röding of the West African marine province. These two species are the only living representatives of a small species complex that had its center in the Caribbean area. The rare *Harpa americana* Pilsbry from the Miocene of the Dominican Republic and Tehuantepec, Mexico is probably close to the ancestral stock of both species. We may conjecture that this stock once inhabited the West Tethyan Sea, or spread to the

Panamic and West African areas from the Caribbean, and species became established there while the group died out in the Caribbean.

H. crenata differs from *doris* Röding in being generally larger, broader, the spire relatively lower and broader, the more slender ribs marked more consistently by a fine interrupted chestnut line, and by the squarish blotches being chestnut-brown rather than pink or orange.

The body whorl is more markedly angulate below the shoulder, the ribs bearing more numerous spines between the subsutural shoulder and the periphery.

Habitat—On clay bottom in 40-55 meters (Parke, 1964, pp. 155, 172).

Description—Shell 32 to 91.5 mm. (1¼ to 3¾ inches) in length, broadly oval, body whorl large, more or less strongly angulate at shoulder. Spire broadly conical; protoconch elevated-mamillate, pale corneous, 3½ whorls, smooth; axis of protoconch and first postnuclear whorl sometimes at a slight angle to that of rest of shell; first postnuclear whorl sculptured with distant axial riblets and two spiral cords forming a coarse reticulate pattern which becomes complicated by addition of further spiral cords; in the second postnuclear whorl the upper spiral cord marks an angulate shoulder, the ribs become more lamellar, and the upper terminus of the ribs curves forward and forms a layer adnate to lower part of preceding whorl; the ribs at the angulate shoulder are produced into a lamellar, triangular spine; occasionally the next spiral row of smaller spines is visible on the penultimate whorl covered by the thin upper edge of the former parietal callus. Body whorl large with a series of subequidistant ribs, generally narrow, triangular in cross section, but occasionally thickened, especially towards the outer lip; the upper portion of the rib marked by a series of three to four spirally aligned triangular spines, the uppermost one, below the subsutural ramp, the largest, while the third one below the suture is next in size and often marks a distinct angulosity of the body whorl; ribs marked on the crest with a narrow interrupted chestnut line; ground color between ribs pale yellowish pink or grayish yellowish pink to pinkish gray or brownish pink with a series of bands of varying width of short, axial, zigzag chestnut lines that occasionally become irregularly broadened on the adapertural side of the ribs, especially near the outer lip. Large irregularly shaped blotches of chestnut are present between the ribs on the upper portion of the body whorl. The color markings of the body whorl appear more conspicuously banded within

the aperture. Aperture ovate, moderately narrow above where there is a deep subsutural sinus and effuse below; outer lip only slightly thickened, bluntly denticulate at edge, especially in basal half; inner lip almost straight to gently concave. Parietal wall covered by a thin glaze, with a large brown-chestnut splotch at the junction of columellar and parietal lip and two splotches of varying sizes, one on parietal wall near junction of outer lip, the other between the columellar lip and the siphonal fasciole.

Measurements (mm.)—

| length | width | no. whorls |
|--------|-------|------------------------------------|
| 92.6 | 63.7 | 7 large; Carmen Id., Baja Calif. |
| 78.9 | 48.8 | 6½ medium; Gulf of California |
| 73.3 | 47.9 | 7½ medium; Mulege Bay, Baja Calif. |
| 64.5 | 39.9 | medium; Gulf of California |
| 34.0 | 21.7 | 6½ small; Gulf of California |

Synonymy—

- 1822 *Harpa crenata* Swainson, Catalogue Shell Colln. Bligh, Appendix, p. 5. (no locality given; Acapulco, Guerrero, Mexico, designated as type locality by Emerson, 1964); 1843, Reeve, Conch. Icon., vol. 1, Harpa, pl. 4, fig. 9a, b, c; 1964, Emerson, American Mus. Novitates, no. 2202, pp. 3-5, fig. 1.
- 1832 *Harpa scriba* Valenciennes, in Humboldt and Bonpland, Voyage reg. equinox. Nouv. Continent, pt. 2, Rec. Observ. zool. anat. comp., vol. 2, p. 323 (Acapulco, Mexico).
- 1834 *Harpa rivoliana* Lesson, Illustr. de Zoologie, (12), pl. 36, fig. 1, 2 ("Japonia?"); 1860, Sowerby II, The-saurus Conch., vol. 3, p. 171, pl. 232, fig. 12, 13 (Acapulco).
- 1835 *Harpa rosca* Kiener, Spec. Gen. Icon. Coquilles Viv., vol. 8, Genre Harpe, pp. 11-12 (in part), pl. 5, fig. 8, Not *Harpa rosca* Lam.
- 1839 *Harpa rosca crenata* Gray, Zoology Capt. Beechey's Voyage, p. 122, pl. 34, fig. 5.

Types—The type of *crenata* Swainson was in Mrs. Bligh's collection which was sold at auction in May 1822. Although many of the rarities came to the British Museum with the Broderip Collection, no specimen that might be considered to be the type was found in that collection; the type must be considered to be lost. The types of *scriba* Valenciennes and *rivoliana* Lesson are not in the Museum National d'Histoire Naturelle in Paris, and their present whereabouts are unknown.

Records—MEXICO-BAJA CALIFORNIA: Mulege Bay (USNM); Loreto; Magdalena Bay (both MCZ); La Paz (AMNH, ANSP, MCZ, RNHL); Cabo San Lucas (USNM); SONORA: Guaymas; Mazatlan (both ANSP, BM, MCZ, USNM); OAXACA: Salina Cruz (USNM). GUATEMALA: off Puerto San José (ANSP). COSTA RICA: Salinas Bay (ANSP, BM); Bahía Huevos, W of Puerto Culebra (ANSP); Golfo de Nicoya (USNM). PANAMA: Isla Coiba (Univ. Panama); Isla Pedro Gonzalez, Islas Perlas (ANSP). COLOMBIA: Isla Gorgona (AMNH).

Fossil Records—PLEISTOCENE: Punta Coyote, Baja California, Mexico (Hertlein, 1957, p. 59); Río Colotepec, Oaxaca, Mexico (Palmer and Hertlein, 1936, p. 68).

Harpa myrmia Olsson, 1931

(Pl. 229)

Range—Lower Oligocene of Peru (Chira formation).

Remarks—The few, heavy ribs and more or less angulate shoulder on the body whorl distinguish this *Harpa* from other species. The suture is covered by the appressed ends of the posterior ends of ribs, and the columellar and parietal callus is thin and spread to some extent over the body whorl. This species is therefore a true *Harpa*, and the earliest known species of this genus.

Through the cooperation of Dr. Katherine V. W. Palmer I have been able to examine the holotype, and have based the following description on this unique specimen.

Description—Shell rather small, 32 mm. (1¼ inches) in length, broadly and angulately ovate, spire broadly conical. Nuclear whorls lost, remaining whorls 4½. The antepenultimate whorl gently convex, with low widely separated ribs and a few fine spiral striae in the upper part of the interspaces. On the last half of the penultimate whorl (the surface of the earlier part is destroyed) there are two or three fine axial riblets (?growth lines) in the interspaces between the ribs which are slightly angulate at the shoulder; spiral striae are evident in the interspaces, and the lower third to a half of the whorl is covered by the adnate forward-curving upper ends of the ribs of the body whorl. The body whorl has nine strong ribs of which the last three are broader than the others; at the edge of the declivous subsutural ramp the ribs are angulate with an obtuse spine which is particularly apparent on the last four ribs; another pronounced angle is present below, giving the



Plate 229. *Harpa myrmia* Olsson, 1931. Lower Oligocene of Peru. 32 mm. (from Olsson, pl. 20, fig. 7).

shell a strongly shouldered appearance; the interspaces show again several strong axial striae, crossed by some more or less obscure spiral striae. Outer lip lost; ventral surface covered by a thin callus. Siphonal fasciole strong, lower end broken.

Length 31.9 mm., width 23.0 mm. Pal. Res. Inst. No. 2138, Chira formation, near Quercotilla, Chira valley, northern Peru.

Synonymy—

1931 *Harpa myrmia* Olsson, Bull. American Paleontology, vol. 17, no. 63, p. 114, pl. 20, fig. 7.

Harpa species

A portion of a shell, found in the Lau Islands, eastern Fiji, is noted here in order to call attention to the presence of this genus in Lower Miocene times in eastern Melanesia. Although the ventral portion is missing, and the remaining portions of the penultimate and antepenultimate whorls are somewhat corroded, it appears that the

expanded portion of the upper ends of the ribs cover in some places about half of that part of the spire whorls between the shoulder angle and the suture. The ribs are fairly closely spaced, and are rather strongly angulate and sub spinose at the shoulder. I am therefore referring this specimen to the *Harpa*, making this one of the oldest representatives of the genus.

Judging from the size of the fragment, the complete shell would measure about 40 mm. in length, close to the maximum size known in *Eocithara*.

It is larger, with a more rounded, less angulate shoulder, than the Indonesian *E. muticaeformis* Martin of the same age.

The shell was collected in tuffaceous limestone on the coast between Tumbou and Tarakua-wai, Lakemba, Lau Islands, Fiji (H. S. Ladd, collector, Sta. L. 389). This is assigned to the base of the Futuna limestone and falls in stage *f* of the Lower Miocene (Ladd and Hoffmeister, 1945, pp. 25, 99, and personal communication).

Genus *Austroharpa* Finlay, 1931

This genus comprises a series of relatively small recent and fossil species from Australia. The adult shells range in size from 20 to 50 mm. in length, and are characterized by a large paucispiral bulbous or dome-shaped protoconch, and axial ribs whose upper ends are only slightly curved forward and hardly visible at the suture. The parietal callus is small but distinct and conspicuously margined, though the outer edge may not be raised or thickened.

I am dividing this genus into two subgenera, *Austroharpa s.s.* and *Palamharpa* Iredale, 1931, largely on the basis of the protoconch, that of the type species of *Austroharpa*, *A. pulligera* (Tate, 1889), being larger, bulbous and apparently tilted, while the species of *Palamharpa* have a smaller, dome-shaped nucleus with the suture marking the earliest whorl being horizontal. In addition *A. pulligera* is larger, 50 mm. in length, while most of the species of *Palamharpa* do not, to my knowledge, reach 40 mm. in length.

Subgenus *Austroharpa* Finlay, 1931

Type: *Harpa pulligera* Tate, 1889

This Middle Miocene subgenus contains only the single species *Austroharpa pulligera* (Tate, 1889) and is characterized, as mentioned above, by the large bulbous nucleus which seems to be tilted and quite different in appearance from the smaller, evenly dome-shaped protoconch of the species I am placing under *Palamharpa*. Because

of this striking character and relatively larger shell-size I am inclined to keep it distinct, especially since it was apparently living with a species, of the subgenus *Palamharpa*, *Austroharpa (Palamharpa) spirata* (Tate, 1889), both being found together in the same Balcombe Clay at Balcombe Bay, Victoria. This suggests that we are dealing with two distinct stocks, whose phylogenetic relationship can only be elucidated by the future discovery of related forms.

Synonymy—

1931 *Austroharpa* Finlay, Trans. New Zealand Inst., vol. 62, pt. 1 (May 31), p. 13.

Austroharpa pulligera (Tate, 1889)

(Pls. 231, 232)

Range—Middle Miocene (Balcombian) of Victoria.

Remarks—This is apparently a rare species, distinct by its size, relatively large among the species of this genus *Austroharpa* in length, its cassid-like form, and large, bulbous protoconch. The type, from Schnapper Point, near Mornington, Victoria, north of Balcombe Bay, measures 50 mm in length; Dr. Thomas A. Darragh (in litt.) informs me that the National Museum of Victoria has eight specimens from Balcombe Bay ranging in length from 38 to 46 mm. He states that the species occurs also at Muddy Creek, near Hamilton, Victoria. As I have not seen specimens I am copying Tate's description:

Shell thin, oval, with a rather short spire, ending in a very large hemispheric pullus, with the tip laterally immersed; the second turn of the pullus almost concealed by the first ordinary whorl. Ordinary whorls one and a half, subangulated; ornamented with thin, slightly elevated lamellae,



Plate 230. Enlarged protoconchs of species of *Austroharpa (Palamharpa)*. Fig. 1. *A. (P.) punctata* (Verco). Off Venus Bay, South Australia, USNM 706971. Fig. 2. *A. (P.) exquisita* (Ire-

dale), off Burleigh Heads, Queensland, ANSP 314410. Fig. 3. *A. (P.) sulcosa* (Tate). Miocene, Hamilton, Victoria, USNM 157219. (all X 10).



Plate 231. *Austroharpa pulligera* (Tate). Holotype, 50 mm. in length. South Australian Museum, Tate Colln. 703.

which are vaulted on the angulation. Last whorl oval-oblong, somewhat ventricose over the suture, ornamented with about 25 thin, slightly elevated lamellae, which are raised into vaulted scales on the shoulder; the interspaces with coarse axial

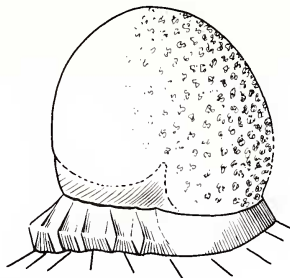


Plate 232. Protoconch of *Austroharpa (Austroharpa) pulligera* (Tate, 1889). (from Cotton and Woods, 1933, p. 46, fig. 8) X 7.5.

striae; base spirally wrinkled. Aperture narrow-oval; outer lip slightly ascending on the penultimate whorl, its margin much thickened.

Dimensions (in mm.)—length, 50, breadth 30, length of aperture 42, diameter of pullus 4.5.

Synonymy—

- 1889 *Harpa pulligera* Tate, Trans. Proc. Rep. Royal Soc. South Australia, vol. 11, p. 151, pl. 6, fig. 9 (Blue clays at Schnapper Point, Mornington, Victoria).
- 1913 *Harpa (Eocithara) pulligera* Tate, Verco, Trans. Royal Soc. South Australia, vol. 37, p. 447.
- 1931 *Austroharpa pulligera* Tate, Finlay, Trans. New Zealand Inst., vol. 62, p. 13.
- 1931 *Denharpa pulligera* Tate, Iredale, Rec. Australian Mus., vol. 18, p. 230.

Remarks—This small, deepwater species was once considered, after *A. (P.) punctata* (Verco), the rarest of the harp shells. It is still uncommon in collections but has been brought up in recent years from moderately deep waters off southern

Subgenus *Palamharpa* Iredale, 1931

Type: *Palamharpa exquisita* Iredale, 1931

This group of recent and fossil Australian species is characterized by its rounded, dome-shaped paucispiral protoconch (1½ whorls), generally small size—from 20 to 35 mm. (the exception is a specimen reconstructed from a fragment of *Austroharpa (Palamharpa) loisae* Rehder which measures 45.8 mm. in length). In sculpture the species are very variable ranging from those with rather crowded lamellar ribs and cancellate sculpture through ones with very little or no spiral sculpture to a smooth species with only weakly indicated, widely separated, axial ribs. The recent species have a rather distinct notch at the upper end of the outer lip below its junction with the suture, which is not apparent in the fossil species.

This subgenus has been considered by some (Cotton and Woods, 1933, p. 47; Wenz, 1943, p. 1310) to be a synonym of *Austroharpa* s.s., but I believe that the striking difference in the protoconch is sufficiently important to warrant for the present their separation. In the many specimens of Harpidae, recent and fossil, that I have examined I have found the protoconchs to be quite constant.

The living species of the subgenus *Palamharpa* are found in moderately deep water from southern Queensland southward around the southern Australian coast to off Perth, Western Australia.

The fossil species range from Upper Oligocene to Upper Pliocene.

Synonymy—

1931 *Palamharpa* Iredale, Rec. Australian Museum, vol. 18, no. 4 (June 29), pp. 230, 233 (type, by original designation: *Palamharpa exquisita* Iredale).

1931 *Denharpa* Iredale, *ibid.* (Type, by original designation: *Harpa clathrata* Tate).

1931 *Tramcharpa* Iredale, *ibid.* (type, by original designation: *Harpa spirata* Tate).

Austroharpa exquisita (Iredale, 1931)

(Pl. 230, fig. 2; Pls. 233, 237, figs. 4, 5)

Range—From off Burleigh Heads, southern Queensland, to Bass Straits, Victoria and Tasmania, in 25 to 80 fathoms.

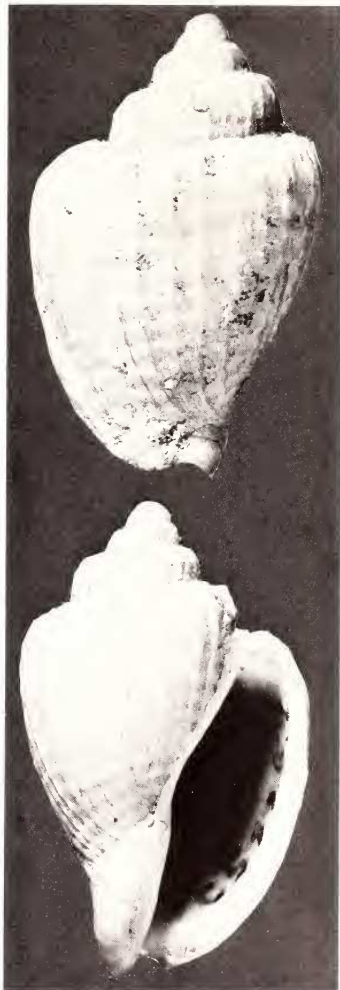


Plate 233 *Austroharpa (Palamharpa) exquisita* (Iredale). Holotype, Australian Museum no. C. 57753, from off Twofold Bay, New South Wales, Australia.

New South Wales and eastern Victoria by commercial fishermen; in the latter locality, according to Mrs. M. C. Griffiths of Lakes Entrance, Victoria, about 10 specimens have been found in the last thirteen years.

Habitat—According to Mrs. M. C. Griffiths (in litt.), specimens of this species are dredged in Bass Straits in an area about 7-9 miles ESE of Lakes Entrance, Victoria, on a bottom consisting of dead shell debris that formed almost a coarse sand.

Description—Shell small, 24-29 mm. in length, broadly ovate with a conical, turreted spire. Protoconch dome-shaped, of $1\frac{1}{2}$ smooth whorls, the earliest part of the first whorl low and well immersed below the horizontal suture in succeeding whorl, last part more convex and impressed at suture; postnuclear whorls of spire with an increasingly angled shoulder, weak distant ribs, and broad low, obscure ridges, one in subsutural ramp, one at shoulder and two below the shoulder; the angulate shoulder and flattened subsutural ramp gives the spire a turreted appearance; between the ribs which become increasingly sublamellar, are numerous axial ridges, about 3 to 6. Body whorl strongly angulate, with about 22 to 27 low, sublamellar axial riblets which are rendered weakly scalloped by the broad, rounded spiral ridges they cross; these spiral ridges number 10-12 below the shoulder; the fine axial ridges between the ribs are sharply and finely sublamellar. Color of nucleus yellowish-pink, of body whorl from pale yellowish pink or moderate yellowish pink to dark orange yellow, with splotches of moderate reddish orange or grayish reddish orange on the subsutural ramp or arranged in obscure bands on body whorl, the spots darker on the lamellar ribs where they cross the spiral ridges. Aperture elongate, inner edge rather straight; outer lip gently arcuate, slightly flattened in center, somewhat flaring, thickened externally, with a definite notch below its junction with the body whorl; parietal-columellar junction indistinctly angulate, parietal callus narrow, distinctly marginate, raised in the area of the base of the body whorl and the siphonal fasciole; siphonal canal rather deep and directed upward.

The soft parts of a specimen from Twofold Bay, New South Wales, sent to me by Dr. D. F. McMichael, then at the Australian Museum, Sydney, preserved in alcohol for some time, show an animal of which the propodium and head and anterior part of the metapodium are without spots; the posterior portion shows spots which are densest at the posterior end.

Measurements (mm.)—

| length | width | no. whorls | |
|--------|-------|------------|-------------------------------|
| 24 | 15 | 5 | Holotype, Twofold Bay, N.S.W. |
| 28.4 | 17 | 5+ | Burleigh Heads, Queensland |
| 29.0 | 17.3 | 5 | Lakes Entrance, Victoria |
| 21.7 | 12.5 | 5 | Eden, New South Wales |

Synonymy—

- 1931 *Palamharpa exquisita* Iredale, Rec. Australian Mus., vol. 18, no. 4 (June 29), p. 230, pl. 22, fig. 8.
 1933 *Austroharpa exquisita* Iredale, Cotton and Woods, Rec. South Australian Mus., vol. 5, p. 47; 1962 Macpherson and Gabriel, Marine Molluscs of Victoria, p. 215, figure 257; 1971 Wilson and Gillett, Australian Shells, p. 110, pl. 72, fig. 6.

Types—The holotype is in the Australian Museum, No. C. 57753, and the type locality, which was not mentioned by Iredale, is off Twofold Bay, New South Wales, in 45 fms.

Records—QUEENSLAND: off Burleigh Heads, in 34 fms. (ANSP). NEW SOUTH WALES: 11 mi W of Crowdy Head, in 50 fms. (AMS); E of Sidney, in 40-82 fms. (AMS); off Crookhaven Bight, in 30-35 fms. (Colln. W. A. Trenerry); Ulladulla (Colln. G. Thornley); off Crabo Id., Twofold Bay, in 50 fms. (AMS); off Twofold Bay, in 45 fms. (AMS, NMV); off Eden, in 50-60 fms. (USNM). VICTORIA: off Hospital Creek, in 30-60 fms.; ESE of Lakes Entrance, in 21-26 fms. (both Colln. M. C. Griffiths); off Lake Tyers (Colln. C. J. Gabriel, W. S. Ayres). TASMANIA: off Deal Id., Kent Group, Bass Straits, in 33 fms. (Garrard, 1961).

Austroharpa loisae Rehder, *new species*

(Pl. 237, figs. 3, 6)

Range—From WSW of Cape Naturaliste to NW of Rottnest Island, Western Australia.

Remarks—This strikingly sculptured species is most closely related to *A. (P.) exquisita* (Iredale) from the southeastern coast of Australia. It differs, however, in being more slender, not as strongly shouldered, in the axial and spiral sculpture being stronger and more regular, and in the protoconch and early whorls being lemon yellow rather than pinkish yellow in color.

A fragment of a large specimen found in 80 fathoms NW of Rottnest Island (SAM 34-70) is the basis for the maximum size mentioned in the description and listed in the measurements below. The height of the penultimate whorl, measured from suture to suture, was compared with the same measurement taken from the holotype; the relationship between these two measurements was equated with the total length of the holotype, and by this means an estimated length for the large specimen was determined.

The holotype has been figured by Wilson and Gillett in their book "Australian Shells" (1971, pl. 72, fig. 6a) as *Austroharpa exquisita* Iredale,



Plate 234. Geographic distribution of 1. *Austroharpa (Palamharpa) exquisita* (Iredale), and 2. *Austroharpa (Palamharpa) loisae* Rehder, new species.

who noted that this form may prove to be a distinct subspecies or species.

This beautiful species is named for my wife in appreciation of her ever willing assistance, encouragement, and understanding.

Habitat—This species has been dredged from depths of from 70 to 103 fathoms, on sandy bottom with sponge and bryozoa.

Description—Shell of medium to relatively large size, thin, adults measuring from 28.4 to 45.8 mm. ($1\frac{1}{8}$ to $1\frac{3}{8}$ inches), ovate, with a rather elevated, conical, and turritid spire. Protoconch almost hemispherical, dome-shaped, paucispiral, of $1\frac{1}{2}$ + smooth whorls, moderate yellow in color. Post-nuclear whorls $3\frac{1}{2}$ in number, the obtuse shoulder marked by a spiral cord, in addition to which there is an obscure spiral cord on the subsutural ramp and more pronounced equidistant spiral cords below the shoulder (3 on the antepenultimate whorl, and 4 on the penultimate whorl). Crossing these cords are thin, rather distant, raised lamellar ribs (25 in the penultimate and 29 on the last whorl); these ribs are noticeably scalloped where they cross the equidistant spiral cords, the scallops being highest on the shoulder and subsutural cords; if the body whorl is viewed against a light, the axial ribs and cords make a very regular, reticulated pattern; between the axial ribs are 6 to 10 very fine, rather regular and somewhat separated, lamellar axial riblets. Color is a pinkish white or yellowish white to a yellowish gray, with the protoconch and first postnuclear whorls a moderate yellow; there are numerous small reddish brown spots where the ribs cross the cords, most noticeable on the abapertural side of the lamellar ribs, and occasionally a few larger spots of pale reddish brown on the subsutural ramp.

Aperture elongate, semilunate, with inner lip only slightly angled at juncture of parietal and columellar portions, and outer lip gently arcuate, somewhat broadly reflected and a little thickened internally, a small but distinct notch present at upper end below junction with body whorl; parietal callus thin, allowing sculpture underneath to be apparent, well margined, with a pronounced margin in adult shells; anteriorly, in the region of the well-developed and strongly lamellate siphonal fasciole, the margin is suberect, resulting in a noticeable pseudumbilical chink; anterior siphon rather deep, upturned.

Measurements (mm.)—

| length | width | no. whorls | |
|--------|-------|-----------------|----------------|
| 28.9 | 16.7 | 5 | Holotype |
| 28.4 | 16.8 | 4 $\frac{1}{2}$ | Paratype No. 1 |
| 45.8* | — | — | Paratype No. 3 |
| 36.4* | — | — | Paratype No. 4 |

*length (approximate) computed from height of penultimate whorl.

Synonymy—

1971 *Austroharpa exquisita* Iredale, Wilson and Gillett, Australian Shells, p. 110 (in part), pl. 72, fig. 6a. Not *Palamharpa exquisita* Iredale, 1931.

Types and Records—WESTERN AUSTRALIA: WSW of Cape Naturaliste, in 75 fms., broken shell (paratype no. 4, WAM 129-63); W of Rottnest Id., in 60 fms. (WAM 156-72); NW of Rottnest Id., in 70 fms. (holotype, WAM 1784-69); NW of Rottnest Id., in 100-103 fms. (paratype no. 1, WAM 31-64); NW of Rottnest Id., in 85 to 95 fms. (paratype no. 2 and fragment, WAM 127/128-63); NW of Rottnest Id., in 80 fms. (fragment, paratype no. 3, WAM 34-70); WSW of Dongara, in 60 fms. (paratype, USNM 707703; WAM 158-72; WAM 159-72); NW of Bluff Point, in 60 fms. (WAM 157-72).

Austroharpa punctata (Verco, 1896)

(Pl. 230, fig. 1; Pls. 235, 236)

Range—The eastern half of the Great Australian Bight, South Australia, from Nuyts Archipelago to Encounter Bay.

Remarks—This striking shell was the first of the living members of this genus to be described, and is still one of the rarest and most sought-after shells; only about twenty specimens are known. It is characterized by its size, relatively large for the subgenus, its inflated shape, and its smooth colored shell which is without any obvious spiral sculpture and has only low, obscure varices with a groove immediately in front of them and marked by scales on the subsutural ramp. It is quite distinct from any other known species, its closest relative being the smaller, more strongly sculptured species *A. (P.) wilsoni* Rehder described below.



Plate 235. *Austroharpa (Palamharpa) punctata* (Verco). Holotype. South Australian Museum D. 13516. Off Newland Head, Encounter Bay, South Australia, in 20 fathoms.

Description—Shell moderately large, 32 to 36.3 mm. in length, inflated-ovate, with short, broadly conical spire, the whorls of which are flattened subsuturally and are convex below the rounded, not angulate shoulder. Protoconch rather large, hemispherical, dome-shaped, of $1\frac{3}{4}$ smooth whorls, the initial $1\frac{3}{4}$ whorls microscopically granulose. Postnuclear whorls $2\frac{3}{4}$ in number, convex, with a flat subsutural shelf, marked by low axial varices which gradually increase in strength; the varices are the outer edges of former lips, with the succeeding shell growth starting below the level of that non-reflected lip-edge, forming in this way a series of distant, overhanging steps, which are highest near the shoulder and gradually diminish in height towards the base; above the rounded shoulder and on the subsutural shelf the varices are marked by large, erect, forward-leaning, concave scales; between the varices the shell is smooth except for irregular, microscopic wavy striae. Color of protoconch and spire whorls a moderate yellowish orange-pink, body whorl varying from a moderate or strong yellowish pink to occasionally a deep yellowish pink or salmon color, with obscure bands and irregular spots of white; the darker, strong yellowish pink color may be patterned as large spots arranged in three bands—on the subsutural shelf and on the middle and lower half of the body whorl; the whole shell

is usually marked with irregular flecks and spots of various sizes and shapes but most frequently triangular, elongate, or sagittate; specimens are occasionally found without spots. Aperture elongate, semilunate, outer lip gently arcuate, rather broadly reflected, only slightly thickened externally and internally, inner surface showing the pink coloration of the external, obscure, darker banding; a strong triangular notch is present at the upper end, at the junction with the parietal wall. Parietal callus small, very thin, with the outer margin obscure; columellar callus with a conspicuous, thickened margin at the siphonal fasciole; siphonal canal short, deep, upturned.

According to a note by the collector of a living specimen from Thorny Passage, the animal is pale orange. The dried soft parts extracted from a specimen from Venus Bay (USNM 706971), and softened in Aerosol O.T., show scattered spots of reddish brown on a pale ground on both foot and tentacles; the siphon is also spotted and indistinctly annulate.

Measurements (mm.)—

| length | width | no. whorls | |
|--------|-------|----------------|----------------------|
| 34.0 | 22.0 | $4\frac{1}{2}$ | Holotype, SAM D13516 |
| 32.5 | 21.5 | $4\frac{1}{2}$ | Paratype, SAM D459 |
| 35.0 | 24.0 | $4\frac{1}{2}$ | SAM D460 |
| 34.8 | 24.9 | $4\frac{1}{2}$ | USNM 706971 |
| 34.7 | 25.1 | $4\frac{1}{2}$ | Colln. Hurrell |
| 36.4 | 24.9 | $4\frac{1}{2}$ | Colln. Delaney |
| 31.9 | 21.4 | $4\frac{1}{2}$ | Colln. Delaney |

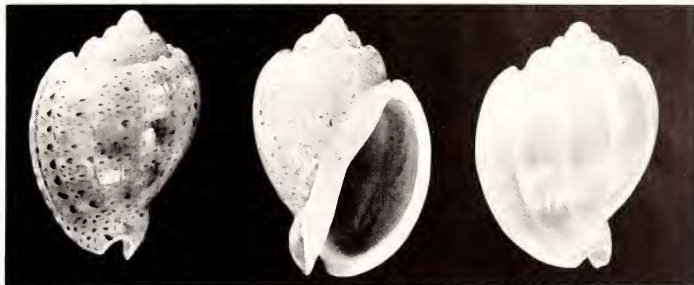


Plate 236. *Austroharpa (Palamharpa) punctata* (Verco). Left fig. off Venus Bay, South Australia, USNM 706971. Center fig. off Encounter Bay, South Australia, Colln. S. T. Delaney. Right fig. off Venus Bay, South Australia, Colln. D. Hurrell. (all natural size).

Synonymy—

- 1896 *Harpa punctata* Verco, Trans. Royal Soc. South Australia, vol. 20, p. 218, pl. 6, figs. 3, 3a, 3b (Newland Head, South Australia).
 1913 *Harpa (Eochthara) punctata* Verco, Trans. Royal Soc. South Australia, vol. 37, pp. 446-447.
 1931 *Austroharpa punctata* Verco, Finlay, Trans. New Zealand Inst., vol. 62, p. 13; 1933, Cotton and Woods, Rec. South Australian Museum, vol. 5, p. 47; 1971, Wilson and Gillett, Australian Shells, p. 110, pl. 72, figs. 5, 5a.

Types—The holotype (SAM D13516) and paratype (SAM D459) are in the South Australian Museum. The type locality is off Newland Head, at the northern end of Encounter Bay, South Australia, in 20 fathoms.

Records—SOUTH AUSTRALIA: St. Francis Id., Nuys Archipelago (SAM D460); off Venus Bay, in 27 fms. (USNM, Colln. D. Hurrell); near Port Lincoln (fide H. M. Laws); Thorny Passage, in 65 to 70 ft. (Colln. S. T. Delaney); Emu Bay, Kangaroo Id. (Colln. F. L. Saunders, fide H. M. Laws); American River, Kangaroo Id. (teste Verco, 1913); Backstairs Passage, in 22 fms. (teste Verco, 1896); Normanville (SAM); off Newland Head, Encounter Bay, in 20 fms. (holotype, SAM); Encounter Bay, in 20 fms. (SAM, Colln. S. T. Delaney).

Austroharpa wilsoni Rehder, new species

(Pl. 237, figs. 1, 2)

Range—From off Cape Leeuwin to off Dongara, Western Australia.

Remarks—This species is most closely related to *A. (P.) punctata* Verco by reason of its similar sculpture; it is, however smaller, more slender, with a relatively higher spire, and the shell a uniform whitish yellow with only occasional spots on the subsutural shoulder.

It is named for Barry R. Wilson of the Western Australian Museum, through whose generosity I

was able to study the Harpidae of Western Australia.

Habitat—All specimens were dredged in depths of from 60 to 120 fathoms on a sandy bottom, often with sponges, bryozoa, and starfish.

Description—Shell small, from about 20 to 25.7 mm. in length, thin, ovate, with an elevated conical spire. Protoconch, hemispherical, dome-shaped, of $1\frac{3}{4}$ whorls that appear smooth but are microscopically granulate; postnuclear whorls convex, with a very weakly angulate shoulder, and a slanted subsutural ramp; the sculpture consists of distant axial ribs, and in the earliest whorls a few low and broad spiral cords that gradually become obscure and are only very weakly indicated on the body whorl at and below the shoulder; in the early whorl the axial varices are more erect and rib-like, but later the varices are lower and have the appearance of low slightly overhanging steps; on the subsutural ramp the varices are more elevated and vaulted and occasionally form an erect, hollow triangular scale. The whole surface is superficially smooth but shows under highpower magnification very fine, obscure, wavy striae and coarser and irregular axial growth wrinkles. Color grayish yellow, occasionally with pale orange brown splotches on the shoulder and series of small light reddish brown spots on the varices behind the sharp edge; these seem to be arranged in spiral series, and on fresh shells a faint indication of spiral banding can be seen on the body whorl; the fine edge of the body-whorl varices shows a reddish brown color where these bands cross, and on the thickened edge of the outer lip the series of red brown blotches is conspicuous; these spots are continued on the inner edge of the thickened outer lip where in some instances the spots become a dark pink color; in dead shells the spots on the lip may disappear; in the holotype the siphonal fasciole is flushed with pink and the columellar callus

where it crosses the fasciole is a pale pink color. Aperture elongate-semilunate with outer lip gently arcuate, thickened internally, narrowly reflected, with a conspicuous, moderately deep sinus below its juncture with the parietal wall; parietal callus small, thin, the margin low but definite on the parietal wall, thickened on the columellar portion with narrow chinks above and below where it crosses the siphonal fasciole; siphon deep, up-turned, its inner surface with a pale rosy flush. Wilson (in litt.) describes the living animal as "white with sparse lemon yellow spots on the sides of the foot and on the head, eye stalks lemon yellow, penis large and white."

Measurements (mm.)—

| length | width | no. whorls | |
|--------|-------|------------|------------------------------|
| 25.3 | 14.7 | 5+ | Holotype (WAM 36-70) |
| 25.7 | 15.6 | 4½ | Paratype No. 1 (WAM 125-63) |
| 24.4 | 15.0 | 4½ | Paratype No. 2 (USNM 703249) |
| 22.8 | 14.1 | 4½ | Paratype No. 3 (USNM 703250) |
| 21.6 | 12.5 | 4½ | Paratype No. 4 (WAM) |
| 19.7 | 11.5 | 4½ | Paratype No. 5 (WAM 35-70) |

Types—The type locality is NW of Rottnest Island, off Perth, Western Australia in 80 fathoms on a bottom of sand with bryozoa and sponges; collected on a cruise of the "Bluefin," Sept. 15, 1965. The holotype is WAM 36-70.

Records—WESTERN AUSTRALIA: W of Cape Leeuwin, in 76-80 fms. (WAM 153-72); WNW of Cape Freycinet, in 107-129 fms. (WAM 154-72); W of Cape Naturaliste, in 96-100 fms. (WAM 155-72); SW of Garden Id., in 81-84 fms. (WAM 152-72); W of Rottnest Id., in 75 fms. (WAM 38-70); WNW of Rottnest Id., in 95-96 fms. (USNM 703250; WAM 122/124-63); NW of Rottnest Id., in 70-103 fms. (USNM 703249; WAM 35-70, 36-70; 125/126-63); WSW of Dongara, in 60 fms. (WAM 150-72); W of Dongara, in 80 fms. (WAM 151-72).



Plate 238. Geographic distribution of: 1, *Austroharpa (Palamharpa) punctata* (Verco), and 2, *Austroharpa (Palamharpa) wilsoni* Rehder, *new species*.

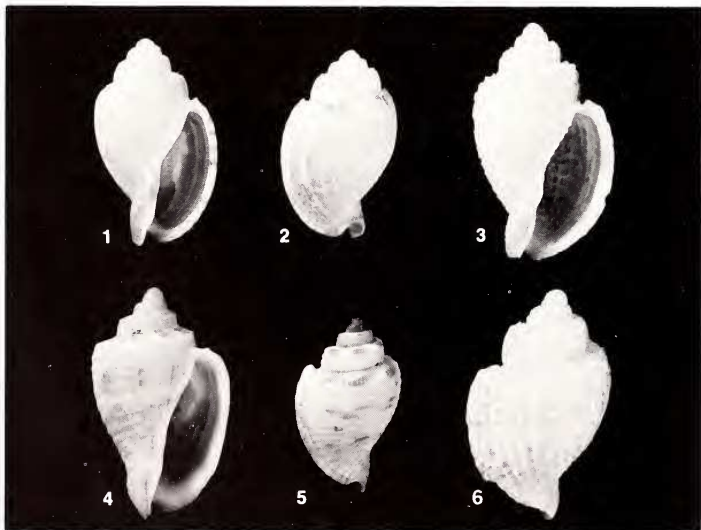


Plate 237. Figs. 1, 2, *Austroharpa (Palamharpa) wilsoni* Rehder, *new species*. 1, holotype, WAM 36-70. 2, paratype, WAM 123-62. Figs. 3, 6, *Austroharpa (Palamharpa) loisae* Rehder, *new species*. 3, holotype, WAM 1784-69. 6, paratype, WAM

31-64. Figs. 4, 5, *Austroharpa (Palamharpa) exquisita* Iredale. 4, off Burleigh Heads, Queensland, ANSP 314410. 5, off Eden, New South Wales, USNM 634267. (all natural size).

Austroharpa sulcosa (Tate, 1889)

(Pl. 239)

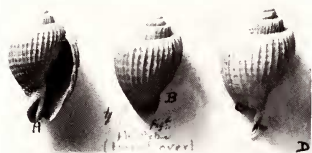
Range—Middle Miocene (Balcombian) of Victoria.

Remarks—A species that seems closest to *A. (P.) exquisita* Iredale but with a lower spire, a somewhat more broadly ovate shape, and with stronger axial and spiral sculpture. The whorls are actually subsuturally canaliculate by the raised angular shoulder on which the axial ribs form erect lamellar and triangular scales. The parietal callus is thin judging from the single specimen with underdeveloped outer lip from the type locality I have been able to examine personally (USNM 157219); this specimen measures 28.2 mm. in length.

According to N. H. Ludbrook, this species is also found in the Fyansford Clay of the Balcombian at Shelford, Victoria.

Synonymy—

- 1889 *Harpa sulcosa* Tate, Trans. Proc. Rep. Royal Soc. South Australia, vol. 11, p. 150, pl. 6, fig. 10 (Muddy Creek, Hamilton, Victoria).
 1897 *Harpa (Eocithara) sulcosa* Tate, Harris, Cat. Tert. Moll. Dept. Geol. British Museum, pt. 1, p. 79.
 1931 *Austroharpa sulcosa* Tate, Finlay, Trans. New Zealand Inst., vol. 62, p. 13; 1933 Cotton and Woods, Rec. South Australian Mus., vol. 5, p. 47, fig. 2 (protocoelch).
 1931 *Refharpa sulcosa* Tate, Iredale, Rec. Australian Museum, vol. 18, p. 230.



Novi Harpa sulcosa, spec. nov. Plat
Hist. Eocene. Muddy Creek

Plate 239. *Austroharpa (Palamharpa) sulcosa* (Tate). Holotype (28.2 mm. in length) and paratypes. South Australian Museum, Tate Colln. 718.

Austroharpa tatei Finlay, 1931

(Pl. 240)

Range—Pliocene (Dry Creek Sands) near Adelaide, South Australia.

Remarks—This species is close to *A. (P.) sulcosa* as Finlay and Ludbrook point out, and even more closely related to *A. (P.) loisae* Rehder of which it may represent an ancestral form. In number of

lamellate axial ribs on the body whorl (33) it is intermediate between *sulcosa*, which has about 38 and *loisae*, which has 29. It is less strongly angulate at the shoulder than *sulcosa*, lacks the spines at the shoulder, and the spiral sculpture is stronger. In all these features it is close to *A. (P.) loisae*. The type measures 25.5 mm. in length and 17 mm. in diameter. It is the Finlay Collection (no. 67) in the Auckland Museum, New Zealand.

Synonymy—

- 1931 *Austroharpa tatei* Finlay, Trans. New Zealand Inst., vol. 62, p. 14 ("Older Pliocene," Abbatoirs Bore, Adelaide, South Australia).
 1958 *Harpa (Austroharpa) tatei* Finlay, Ludbrook, Trans. Royal Soc. South Australia, vol. 81, p. 73, pl. 4, fig. 5.



Plate 240. *Austroharpa (Palamharpa) tatei* Finlay. Holotype, Auckland Institute and Museum. 25.5 mm. (copied from Ludbrook, 1958).

Austroharpa spirata (Tate, 1889)

(Pl. 241)

Range—Middle Miocene (Balcombian) of Victoria.

Remarks—This species is closely related to *sulcosa* Tate but has stronger sculpture, with the axial ribs broader and subequal and with more pronounced spiral cords, both resulting in a strongly fenestrated sculpture. Below the narrow

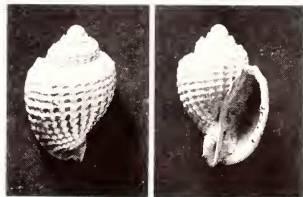


Plate 241. *Austroharpa (Palamharpa) spirata* (Tate). Shelford, Victoria. 26.5 mm. in length. South Australian Museum, P4257.

subsutural channel the subsutural ramp slants to the angulate shoulder, with the axial ribs bearing erect scales at the border of the narrow sutural channel.

The holotype of *A. (P.) spirata*, which measured 35 mm. in length has disappeared, according to N. H. Ludbrook, who has furnished the photograph which depicts a specimen from Shelford, Victoria.

Synonymy—

- 1889 *Harpa spirata* Tate, Trans. Proc. Rep. Royal Soc. South Australia, vol. 11, p. 150, pl. 6, fig. 3 (Blue clays at Schnapper Point—Mornington, Victoria).
 1931 *Austroharpa spirata* Tate, Finlay, Trans. New Zealand Inst., vol. 62, p. 13; 1933, Cotton and Woods, Rec. South Australian Mus., vol. 5, pp. 45, 47, fig. 3 (protoconch).
 1931 *Tramcharpa spirata* Tate, Iredale, Rec. Australian Museum, vol. 18, p. 230.

Austroharpa tenuis (Tate, 1889)

(Pls. 242, 243)

Range—Lower to Middle Miocene (Batesfordian to Balcombian) of Victoria.

Remarks—This species is larger than most of the other species and differs from the previous two species in the reduction of the spiral sculpture to low, more or less obscure ridges. It resembles in this respect the recent *A. (P.) exquisita* Iredale but



Plate 242. *Austroharpa (Palamharpa) tenuis* (Tate). Holotype (34.5 mm. in length) and paratypes. South Australian Museum, Tate Colln. 702.

the latter has a higher spire, more angulately shouldered whorls, and the ribs are not spinose at the shoulder.

Besides the type locality of Muddy Creek, Hamilton, Victoria, this species is also found at Royal Park, Victoria in the Newport formation of the Balcombian (Middle Miocene), and from Flinders, Victoria, in the Batesfordian of the Lower Miocene.

The type according to Tate, measured 36 mm. in length and 23 mm. in width. A specimen in the collections of the USNM measures 36.2 in length and 21.7 mm. in width.

Synonymy—

- 1889 *Harpa tenuis* Tate, Trans. Proc. Rep. Royal Soc. South Australia, vol. 11, p. 151, pl. 6, fig. 1 (Muddy Creek, Hamilton, Victoria).
 1897 *Harpa (Eocithara) tenuis* Tate, Harris, Cat. Tert. Moll. Dept. Geol. Brit. Mus., pt. 1, p. 80, pl. 4, figs. 4a, 4b (protoconch).
 1931 *Austroharpa tenuis* Tate, Finlay, Trans. New Zealand Inst., vol. 62, p. 13; 1933, Cotton and Woods, Rec. South Australian Museum, vol. 5, p. 47, fig. 9 (protoconch).
 1931 *Denharpa tenuis* Tate, Iredale, Rec. Australian Museum, vol. 18, p. 230.

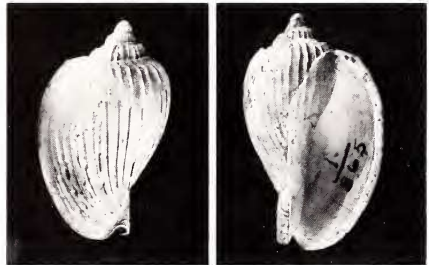


Plate 243. *Austroharpa (Palamharpa) tenuis* (Tate, 1889). Clifton, Victoria. Balcombian (Middle Miocene). USNM 647308. 36.2 mm.

Austroharpa abbreviata (Tate, 1889)

(Pl. 244)

Range—Middle Miocene (Balcombian) of Victoria.

Remarks—This species has a close resemblance in shape and nature of axial ribs to *A. (A.) pulligera* Tate, but differs in size and in the nature of the protoconch. It is fairly closely related to *A. (P.) tenuis* Tate but has fewer axial ribs, the whorls are not as strongly shouldered, the ribs do not bear the erect scales at the shoulder angulation, and the spiral sculpture appears to be absent or is at least very obscure.



T 710

Harpa abbreviata,

Eocene, Mullig's Creek

Plate 214. *Austroharpa (Palamharpa) abbreviata* (Tate). Holotype (27.5 mm. in length). South Australian Museum, Tate Colln. 710.

Synonymy—

- 1889 *Harpa abbreviata* Tate, Trans. Proc. Rep. Royal Soc. South Australia, vol. 11, p. 150, pl. 6, fig. 7.
 1897 *Harpa (Eocithara) abbreviata* Tate, Harris, Cat. Tert. Moll. Dept. Geol. British Museum, p. 81, pl. 4, figs. 5a-b (protoconch).
 1931 *Austroharpa abbreviata* Finlay, Trans. New Zealand Inst., vol. 62, p. 13, 1933, Cotton and Woods, Rec. South Australian Museum, vol. 5, pp. 45, 47, fig. 7 (protoconch).
 1931 *Deniharpa abbreviata* Tate, Iredale, Rec. Australian Museum, vol. 18, p. 230.

Austroharpa clathrata (Tate, 1889)

(Pl. 245)

Range—Lower Miocene (Batesfordian) of Victoria.

Remarks—This relatively large species is distinguished by the rather broad shell with a low conical spire, the fairly distant, narrow axial ribs crossed by strong subequidistant cords, the intersections at and just below the shoulder cord marked by subspinose nodes. The parietal callus is distinctly margined at its outer edge. The holotype measures about 39 mm.

Synonymy—

- 1889 *Harpa clathrata* Tate, Trans. Proc. Rep. Royal Soc. South Australia, vol. 11, p. 151, pl. 6, fig. 8 (Murray River cliffs, near Morgan, South Australia).
 1931 *Austroharpa clathrata* Tate, Finlay, Trans. New Zealand Inst., vol. 13, p. 13, 1933, Cotton and Woods, Rec. South Australian Museum, vol. 5, p. 47, fig. 5 (protoconch).
 1931 *Deniharpa clathrata* Tate, Iredale, Rec. Australian Museum, vol. 18, p. 230.

Austroharpa pachycheila (Tate, 1894)

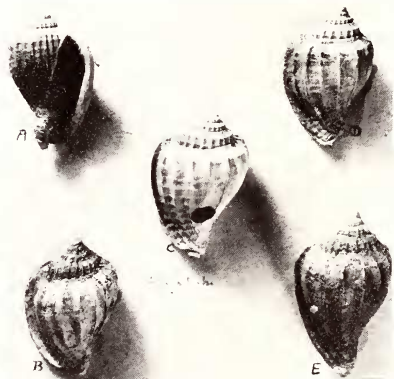
(Pl. 246)

Range—Upper Oligocene (Janjukian/Longfordian) of Victoria.

Remarks—This and the following species, *A. (P.) cassinoides* Tate, were placed by Finlay (1931, p.



Plate 245. *Austroharpa (Palamharpa) clathrata* (Tate). Holotype (38.2 mm. in length) and paratypes. South Australian Museum, Tate Colln. 699.

Name *Harpa pachycheila* sp. nov.

Hab. Eocene, Spring Creek T 712

Plate 246. *Austroharpa (Palamharpa) pachycheila* (Tate). Holotype (at center; 27.5 mm. in length) and paratypes. South Australian Museum, Tate Colln. 712.

12) in the family Cassidae, "perhaps as *Oniscidia*," because of the character of the protoconch, and probably also because of their heavy "cassid" appearance. Three specimens of *pachycheila* are in the collections of the U.S. National Museum of Natural History, and all have a protoconch that is close to that found in the recent *Austroharpa* (*Palamharpa*) *exquisita* Iredale and related species, differing merely in being smaller, with a smaller initial whorl, and a somewhat more impressed suture; these appear to be differences of degree only. Drawings of the apical whorls of the holotype and paratypes of *pachycheila*, kindly sent me by Dr. N. H. Ludbrook, show that both kinds of protoconch are present in the type lot.

A. (P.) pachycheila Tate is a rather stout shell, strongly angulate at the shoulder, the ribs not lamellate but triangular in cross-section; in the first postnuclear whorl spiral cords crossing the axial ribs create a cancellate sculpture; the spiral cords diminish in strength, except for the one at the shoulder angle, particularly in the area below the shoulder. The outer lip is thickened and reflected, and the parietal callus is usually conspicuously marginate.

In general aspect and characters this species is close also to *A. (P.) clathrata* Tate.

The holotype measures 27.5 mm. in length. The three specimens mentioned above measure from 23.8 to 26.8 in length, and from 15.0 to 17.4 mm. in width.

Synonymy—

- 1894 *Harpa pachycheila* Tate, Jour. Royal Society New South Wales, vol. 27, p. 173, pl. 11, fig. 5 (Spring Creek—Torquay, Victoria).

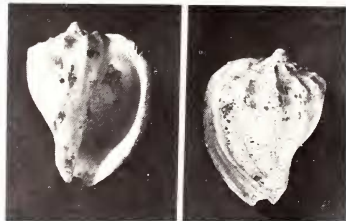


Plate 247. *Austroharpa* (*Palamharpa*) *cassinoides* (Tate). Holotype, 29 mm. in length. South Australian Museum, Tate Colln. 692.

- 1931 [*Oniscidia*] *pachycheila* Tate, Finlay, Trans. New Zealand Inst., vol. 62, p. 12.
 1931 *Deniurpa pachycheila* Tate, Iredale, Rec. Australian Museum, vol. 18, p. 230.
 1933 *Austroharpa pachycheila* Tate, Cotton and Woods, Rec. South Australian Museum, vol. 5, pp. 45, 47, fig. 6 (protoconch).

Austroharpa cassinoides (Tate, 1889)

(Pl. 247)

Range—Lower Pliocene (? or Upper Miocene) to Upper Pliocene of New South Wales and South Australia.

Remarks—This species, together with *A. (P.) pachycheila* Tate and possibly also *A. (P.) clathrata* form a group of rather broad, angulate or subangulate, stout species with non-lamellar ribs, thickened, reflected lip that resemble in general appearance certain members of the Cassidae, and are rather dissimilar to most species of the living Harpidae. However, because their protoconchs approach those of more typical members of the subgenus *Austroharpa* (*Palamharpa*), and since most Australian workers, who have seen more material than I have, retain these species in this group, I follow their example.

This present species is the most aberrant of all members of this subgenus, and is characterized by its short, stout and broad shell, short spire, diminished number of strong non-lamellar ribs that are subnodose at the shoulder, lack of spiral sculpture, and a thickened, reflected outer lip, whose upper end is flexed upwards, projecting over the penultimate whorl to the antepenultimate whorl.

The type measures about 29.5 mm. in length and 22 mm. in width.

Synonymy—

- 1889 *Harpa cassinoides* Tate, Trans. Proc. Roy. Soc. South Australia, vol. 11, p. 150, pl. 6, fig. 4 (Well sinking Murray Desert—Tareena, New South Wales).
 1931 [*Oniscidia*] *cassinoides* Tate, Finlay, Trans. New Zealand Inst., vol. 62, p. 12.
 1931 *Deniurpa cassinoides* Tate, Iredale, Rec. Australian Museum, vol. 18, p. 230.
 1933 *Austroharpa cassinoides* Tate, Cotton and Woods, Rec. South Australian Museum, vol. 5, p. 47, fig. 4 (protoconch).
 1958 *Harpa (Austroharpa) cassinoides* Tate, Ludbrook, Trans. Royal Soc. South Australia, vol. 81, p. 74, pl. 4, fig. 4.

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